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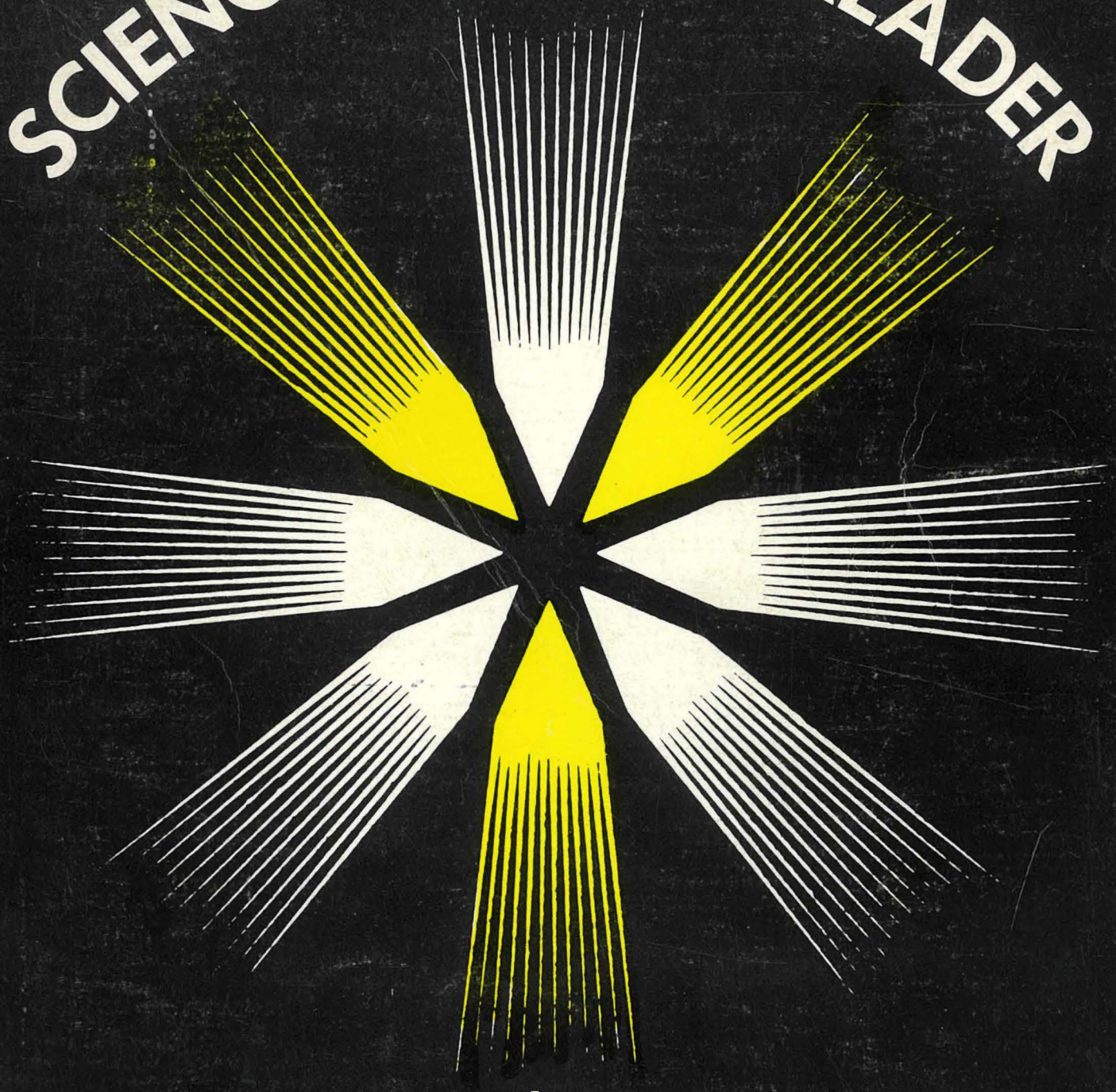
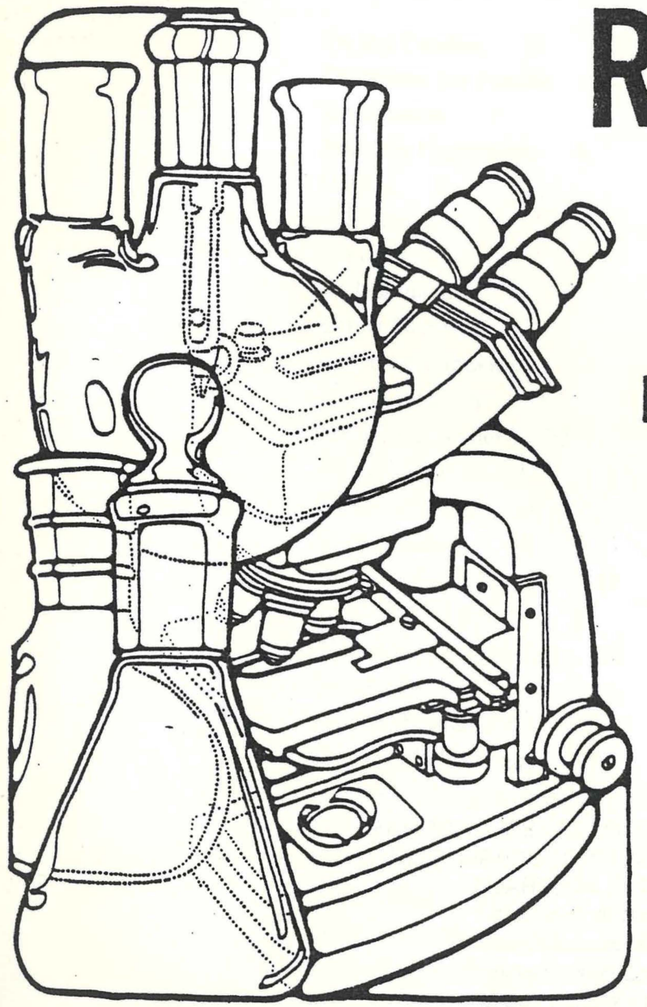
SCIENCE ACTIVITY READER



by

E. Richard Churchill and Linda R. Churchill

SCIENCE ACTIVITY READER



E. Richard Churchill
and
Linda R. Churchill

HBE
Hawker
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Education

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To the Teacher

This activity reader was prepared to acquaint students with certain people who have stood out as leaders in the world of science. It is designed to accompany any science textbook. Since this reader deals exclusively with biographical information, it can explore interesting details that a standard text may not have room for.

The biographies in this collection were selected for their appeal to students. They were also chosen to supplement most science courses. Many familiar names appear in this activity reader, as well as some that are not so familiar. But all the people whose lives are sketched in this volume have made an impact on the world of science.

How might the activity readers best be used? One copy should be given to each student. Students should be allowed to write in them and, at the end of the year, take them home. Don't expect any student to begin with the first biography and then work straight through the reader. Assign biographies for study as they supplement class work. You might occasionally want to skip a biography that is not appropriate. Use the reader to supplement your course of study, not replace it.

Entire classes may use this activity reader. Small groups or individual students may use it with equal success. It is designed for independent use so that the teacher is free to supervise other class activities. Each biography with its accompanying puzzle is self-contained. The student may open the reader to any biography and begin work without having to complete a prior assignment.

The puzzle that follows every biography provides a quick review of the material just read. The italicize words in the body of the biography serve to facilitate a successful puzzle solution. This success aspect of the reader stimulates students who are reading below level. The below-level reader who successfully completes a biography and puzzle is likely to be willing and even anxious to repeat the performance when next given the opportunity to use this activity reader.

The study of the people who made history in the science world is often more interesting than the study of ideas and events. And students who can relate to the scientists as human beings are often able to get more out of their ideas. This activity reader enables students of elementary school reading ability to explore the lives of important people in science. And they can do it without having to fight their reading handicap.

Directions for Puzzles

CRISSCROSS

In the reading, find the correct answer for each clue. Spell out the answers, one letter to a square, beginning in the square that is numbered the same as the clue. When there are two words, do not skip a square.

HIDDEN WORDS

Read the clues listed below the puzzle. Find the word or phrase in the reading that answers each clue. Fill in the blank to the left of the clue. Then locate the word in the letter maze. All of the answers are in the maze. They are written up and down, across, or even on a diagonal. Some are written backwards. A few overlap each other. Circle each answer when you find it in the maze.

FILL-INS

Read the clues given below the puzzle, then find each answer in the reading. Spell out the answer in the spaces provided. One letter of each answer has already been filled in.

Archimedes

Archimedes was the greatest scientist and mathematician of ancient Greece. In fact, his accomplishments have influenced science for two thousand years!

Archimedes was born in *Syracuse* about 287 B.C. His father was an astronomer, and Archimedes grew to love science. He had a brilliant mind and was sent to *Alexandria*, in *Egypt*, to study. His teacher in Alexandria was *Conon*, who had been a student of the mathematician Euclid. Archimedes stayed in Alexandria for a time, but later returned to Syracuse.

King *Hieron* of Syracuse once asked Archimedes to solve a problem for him. He had received a new *crown* from a goldsmith, and he wanted to be sure that the crown was all *gold* before he paid the price asked by the goldsmith. Archimedes had to figure out if it was all gold, but without damaging the crown.

Archimedes was not sure how to begin until he took a *bath* one day. The servants had filled the bath too full and it had overflowed when Archimedes got in. It occurred to Archimedes that the amount of water that spilled was directly related to the volume of his body. He realized that he could put the crown into the water and measure how high it made the water *level* rise. He could then put in an equal weight of gold and see if it made the water rise in the same level that the crown did. If the water rise was equal, the crown was pure gold. If the crown had a mixture of metals in it, then the water rise would be different. This became the principle of buoyancy. Archimedes found out that the crown was not pure gold, and the king had the goldsmith executed for trying to cheat him!

Archimedes also worked out the principle of the lever. This principle explains how a very heavy object can be moved using leverage. To pry up a boulder, for example, you might first insert a long piece of wood under the boulder. Then place a smaller stone under the wooden lever a short distance away from the boulder. This stone becomes the *fulcrum*, on which the lever will turn. Then the other end of the

lever can be pushed down toward the earth. As that end moves toward the earth, the other end will force the boulder up.

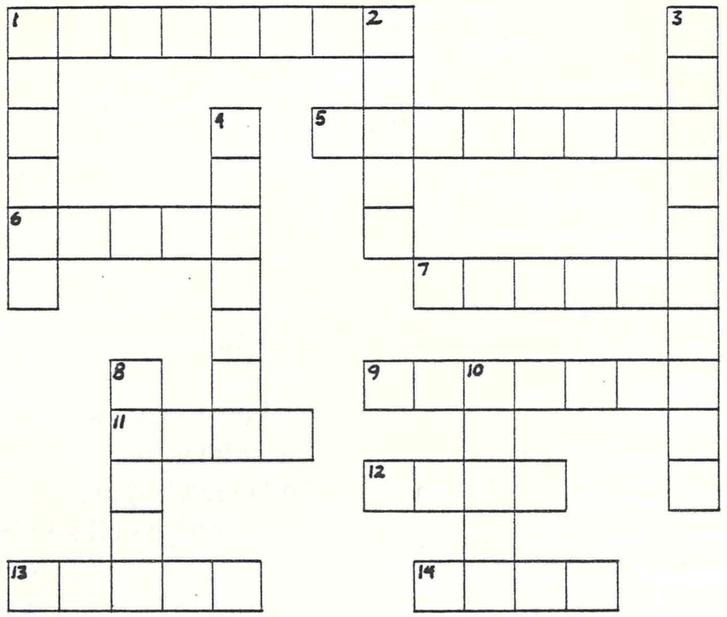
Archimedes was also a mathematician. He figured out a value for "π," called "pi." "Pi" is the *ratio* of the circumference of a *circle* to its diameter. Archimedes also became famous for figuring the number of grains of sand it would take to fill the entire universe. He did this for a reason. He really didn't care how many grains of sand it took. He wanted to prove that nothing real was too big to measure. He felt that everything could be measured. He had a lot of faith in the power of mathematics.

There was another side of Archimedes. He was not satisfied by just sitting and thinking abstract scientific thoughts. He was also a *warrior*-scientist. His country became involved in the wars between *Rome* and *Carthage*. While Hieron was alive, the country joined Rome against Carthage. When Hieron died, however, the next king joined Carthage against Rome. This caused the Roman fleet to attack Syracuse.

It was Archimedes who arranged the defense of Syracuse. According to legend, he made large lenses that set the Roman fleet on fire. He also designed huge cranes to lift the ships out of the water and turn them over. Legend says that the Romans became so fearful of what Archimedes would think up next that they were very careful when they attacked Syracuse.

It was a long battle, but Rome's power proved too great. In the process of taking the city, a Roman soldier found Archimedes drawing in the sand. He ordered Archimedes to come with him. Archimedes was busy working out a theory and refused. The soldier did not realize that the "crazy old man" was Archimedes, and he killed him. The Roman commander was angry because Archimedes was to have been taken alive. Archimedes was given an honorable funeral and buried.

$\pi = 3.14159265+$



ACROSS

1. Rome and _____ fought each other.
5. Archimedes was born in _____.
6. In the principle of buoyancy, the water _____ changes.
7. King _____ asked Archimedes for help.
9. Archimedes was a scientist and a _____ too.
11. A fleet from this city conquered Syracuse.
12. Archimedes was in a _____ when he discovered the principle of buoyancy.
13. Archimedes's teacher.
14. The crown was supposed to be made of _____.

DOWN

1. Archimedes worked with the circumference of a _____.
2. Country Archimedes studied in for a while.
3. City Archimedes was in when he studied with Euclid's student.
4. Object on which a lever rests.
8. Archimedes had to see if the King's _____ was really what it was supposed to be.
10. "Pi" is the _____ of the circumference of a circle to its diameter.

Nicholas Copernicus

Nicholas Copernicus was born in *Torun* on February 19, 1473. He was reared by his uncle because his father died when Nicholas was ten years old. Nicholas's uncle was a wealthy man, so Nicholas got a good education. He studied mathematics and painting at *Cracow*, which was the center of learning in *Poland*.

When Copernicus was twenty-three, he traveled to *Italy*. He was interested in learning new things, and Italy was still the center for learning in Europe. Copernicus began to study medicine. He studied this for a time, then studied *canon law*. Canon law was the law under which the Catholic Church operated.

After reading the works of *Regiomontanus*, Copernicus became interested in astronomy. In fact, he threw himself into the study of astronomy. Italy was a good place to study since there were so many other people there who were involved in learning. Oftentimes these students would get together to question an idea that had been held for a long time. And one of the areas in which there were many questions was astronomy.

The universe had been explained by Hipparchus and Ptolemy a long time before Copernicus. They said that all heavenly bodies rotated around the *Earth*. They established astronomy tables to show where each planet or star would be on any date. By the time of Copernicus, these tables had been corrected by other astronomers, but were still way off in predicting the positions of heavenly bodies.

In 1507 Copernicus saw how much easier the astronomy tables would be if the *sun* were the center of the universe. This would put the Earth and other *planets* in revolution around the sun. This was not a totally new idea, but Copernicus began to work on it. He worked out the system in mathematical detail to show how the paths of the planets could be calculated.

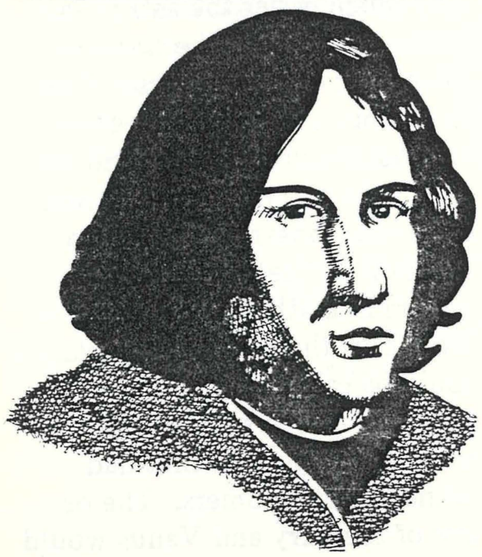
The new system explained some of the puzzles that had bothered astronomers. The orbits of Mercury and Venus would

never be far from the sun if they rotated around the sun. If they rotated around the Earth, why didn't their orbits change more?

Many things were explained by the new system of Copernicus. He wrote a *book* describing his system of planetary motion, but didn't publish it right away. He was afraid his ideas would get him into trouble with the Church. The Church believed that the Earth was the center of the universe because God had chosen to put humans on the Earth.

When Copernicus returned to Poland, he became a canon at the cathedral of *Frombork*, where his uncle lived. Copernicus worked with the Church but never became a priest.

Finally, in 1530, Copernicus prepared a manuscript of his ideas on planetary motion. He sent the manuscript to friends of his to review. They were interested in the new ideas and suggested that Copernicus publish it. Copernicus agreed and dedicated the book to Pope *Paul* III.



The mathematician *Rheticus* thought Copernicus's ideas were so good that he agreed to oversee the publication. Rheticus, however, had to leave town to take a new position in Leipzig. He left Andreas *Osiander* in charge of the printing. Osiander was a Lutheran minister who did not like Copernicus's ideas. He wrote a preface for the book that said the theory was just an easy way to figure the planetary tables, and that it was not a description of actual facts. This preface hurt the arguments that Copernicus had set down in the book.

Copernicus died the same year as the book was published. He did not have a chance to see if his ideas would be accepted or not. He did not live to see his book banned by the Catholic Church. Copernicus had begun a scientific revolution that would eventually overthrow the ideas of the Greek thinkers and allow scientists to investigate problems that were once thought to be totally solved.

S U N A T N O M O I G E R
A N P L A N E T N O N A C
L U N U R O T W O C A R C
O S I A N D E R Y L A T I
H A W P O L A N D U S H K
C L O N K S U C I T E H R
I P B O O K R O B M O R F
N U N K E R B R O K E P N

_____ 1. First name of Copernicus.

_____ 2. Copernicus wrote a _____ about his ideas.

_____ 3. City in which Copernicus studied.

_____ 4. The Greeks felt that the _____ was the center of the universe.

_____ 5. The mathematician named _____ liked Copernicus's ideas.

_____ 6. The Earth is a _____.

_____ 7. Copernicus felt that the _____ was the center of the universe.

_____ 8. Copernicus studied _____ law.

_____ 9. Country in which Cracow is located.

_____ 10. City in which Copernicus was born.

_____ 11. Andreas _____ wrote the preface for Copernicus's book.

_____ 12. The book was dedicated to Pope _____ III.

_____ 13. Country in which Copernicus studied medicine.

_____ 14. After reading the books of _____, Copernicus became interested in astronomy.

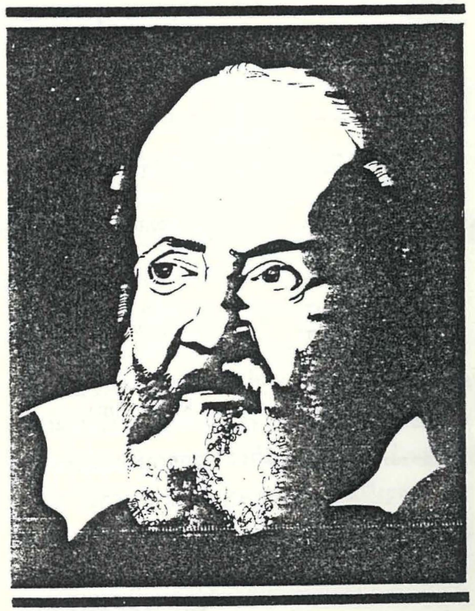
_____ 15. Copernicus became a canon at the cathedral of _____.

Galileo

Galileo *Galilei* was born in *Pisa*, Italy, on February 15, 1564. Galileo was the son of a mathematician. His family had been wealthy, but they had lost most of their money. Galileo's father wanted his son to get into a profession that would make money. He wanted Galileo to be a doctor. For a time Galileo didn't care what he studied. Then, one day, he heard a lecture on geometry. He loved it and looked up the works of Archimedes. Galileo was so interested that he went to his father. He talked his father into letting him study mathematics and science.

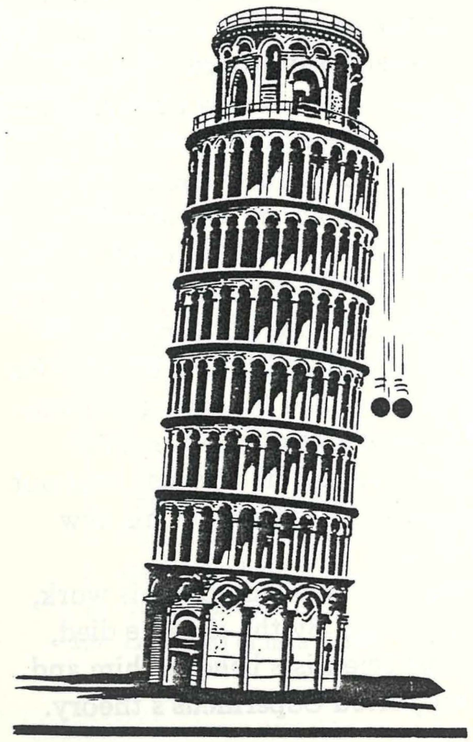
Galileo became the turning point in the history of science. He did not just observe things. He would *experiment* to prove his idea or theory. He always tried to find some mathematical relationship that would explain his theory. Galileo made experimentation interesting to others. He had the ability to write, too. He described his experiments and theories so others could read and understand them.

The first of Galileo's discoveries came when he was seventeen. He was in the cathedral of Pisa listening to the service. He was bored! He found himself watching a swinging chandelier. The air currents were moving it back and forth. As Galileo studied it, the swing seemed to take the same length of time whether it was a wide one or a small one. Since he didn't have a watch with a second hand, he checked the time of the swings with his *pulse* beat. They took the same length of time. When Galileo got out of the service, he



went home and set up two pendulums of equal length. He set one going in large sweeps and one going in small sweeps. They kept together.

Galileo began to study the behavior of falling bodies. Aristotle had said that the heavier the body was, the faster it would fall. Galileo worked on this idea. He found that in a vacuum both bodies would fall at the same rate no matter how large or small. Galileo went on to find that weight did not affect how fast or slow an object fell. The size of the object did, because of



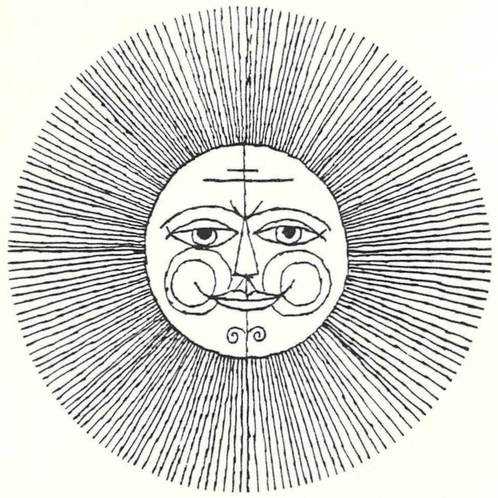
resistance from the air. Legend says that Galileo tried out his idea by dropping two cannon balls, one ten times heavier than the other, from the *Leaning Tower* of Pisa. Both were seen and heard to land together.

Further experiments with falling bodies served as the basis for the laws of motion described later by Sir Isaac *Newton*.

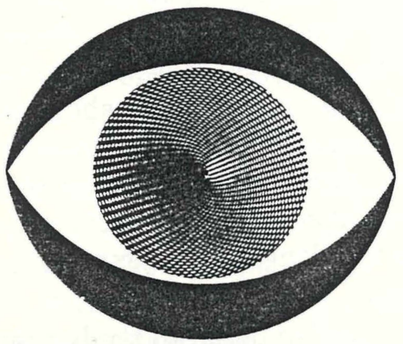
Galileo's radical ideas made him unpopular in Pisa. He moved to *Padua* where he took a better paying position. Galileo had never handled money well. He always seemed to be in debt. And he continually got into trouble by making himself unpopular with important people. His students always thought he was great. But this only caused his fellow teachers to dislike him. They were jealous of his popularity with the students.

As early as 1597, Galileo began writing Johannes *Kepler*, a German astronomer. Galileo finally admitted that he believed that *Copernicus*'s ideas about the *sun* being the center of the universe were correct. He kept these ideas quiet, however, because it was too dangerous to express them.

Galileo began to study the universe. He built himself a telescope and used it to view the



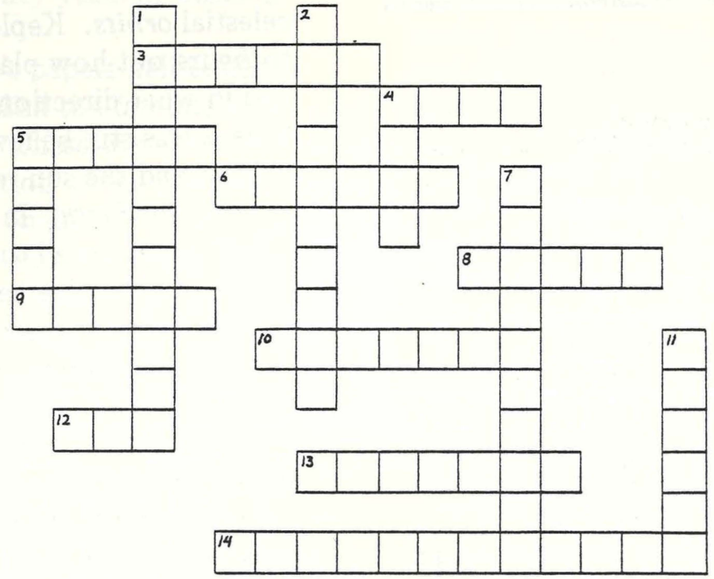
sun and moon. He found sun *spots* and, using these, proved that the sun rotated on its axis every twenty-seven days. Again his ideas made him unpopular. And he had damaged his eyes by studying the sun. This would cause him to go blind in his later years.



He found more stars with the telescope than could be seen without one. He found that ***Jupiter*** had four moons. And he was able to work out the path of the moons around Jupiter. With this, Galileo proved that not all bodies rotated around the *Earth* as was believed at that time. He went on to study Venus and prove that Copernicus had been correct with his theory.

Galileo published his findings that the sun was the center of the universe. Many scientists began to think about his ideas. More, however, began to speak against Galileo. The scientists who thought he was wrong went to the *pope*. The pope forced Galileo to stop spreading his new ideas. When a new pope became the leader of the Church, Galileo published a book about his new ideas. Again he was attacked by scientists. He was brought before the *Inquisition* on charges of *heresy*. He was forced to speak against his new beliefs. He was punished by having to recite psalm verses once a week for three years. He was also told not to talk or write about his new ideas.

Galileo had done his work, however. By the time he died, most scientists believed him and supported Copernicus's theory.



ACROSS

3. Galileo's ideas were turned into the laws of motion by Sir Isaac _____.
4. The _____ was the head of the Church.
5. Galileo moved to _____.
6. Galileo was charged with _____.
8. Galileo studied sun _____.
9. Many scientists believed that the _____ was the center of the universe.
10. Galileo discovered the moons of _____.
12. Galileo was blind because he looked at the _____.
13. Galileo's last name.
14. Galileo dropped cannon balls off the _____ _____ of Pisa.

DOWN

1. Galileo was brought before the _____.
2. This man first believed the sun was the center of the universe.
4. Galileo was born in this city.
5. Galileo used his _____ beat as a timer.
7. Galileo used to _____ to prove his theories.
11. Last name of man Galileo wrote.

Johannes Kepler

Johannes *Kepler* was born in *Germany* on December 27, 1571. Kepler was a brilliant student. He attended elementary schools as other boys did, but he was different. He worked to get *scholarships* that helped pay for his schooling. He finally attended the University of *Tubingen*, where he was trained in *mathematics*.

In 1593, Kepler was appointed a teacher of mathematics. Mathematics was only one field in which Kepler was interested. He became fascinated with *astronomy*. Kepler made money teaching mathematics, but he enjoyed astronomy more.

Kepler studied astronomy because he loved it. He kept notes on his ideas and tried to become one of the best astronomers of his day. By trying to be the best, Kepler came to the attention of Tycho *Brahe*. Brahe was interested in Kepler's ideas on celestial *orbits*. Kepler was trying to figure out how planets move and in what directions. At this time it was still believed that the planets and the sun revolved around the *Earth*. In fact the Earth was believed to be the center of the universe.

Johannes Kepler began to have troubles, however. Kepler was a Protestant, and he was teaching in the town of *Styria*. In 1599 religious troubles became too much for him. The people in Styria were mainly Catholic, and they began to persecute those who were not. The situation became unbearable for Kepler. Brahe invited Kepler to come to *Prague* where there were no religious troubles. Kepler was happy with Tycho Brahe's invitation. He moved to Prague to work with Brahe in astronomy.

Kepler worked with Brahe on new astronomical tables. They were called the *Rudolphine* tables. Brahe died in 1601, but Kepler did not leave Prague. Kepler continued to work on the Rudolphine tables, which were completed in 1624 and published in 1627.

Two important things then occurred for Kepler. He was appointed imperial mathematician and astronomer. He also inherited all of Brahe's *papers*, which included twenty years of observations.

Brahe's papers helped Kepler to establish the famous Kepler's Laws. These were three laws of motion of the planets. These laws enabled Sir Isaac *Newton* to discover the laws of gravitation. These laws of Kepler's showed that he was one of the world's greatest astronomers. He has also been called the real founder of astronomy.

Kepler did not try to fit his theory of motion to *comets*. Comets, he felt, never returned to the universe once they left. Kepler believed the tail of the comet showed that the sun was driving or forcing the body of the comet out of the universe. He was wrong in these beliefs because many comets return on a regular basis.

Kepler worked with *telescopes*, too. He was one of the first astronomers to discover the theory behind the telescope. He was one of the first to lay down the rules for finding the focal lengths of single lenses and the magnifying power of telescopes.

The later part of Johannes Kepler's life was busy. He had spent a good deal of his life writing his ideas so others would read and understand. He wrote to other astronomers about his ideas and theories. He also moved to the town of *Linz*. In Linz he again was a professor of mathematics. Kepler's mathematics background had helped him to become a great astronomer.

Johannes Kepler died on November 15, 1630, just before his sixtieth birthday. The world of astronomy owes much to Tycho Brahe for leaving his observations to Kepler. It also owes much to the mathematical mind of Johannes Kepler, who was able to figure out the laws of planetary motion.

S P I H S R A L O H C S
T U B I N G E N P E A C
Y O R E L P E K A P C I
R E U G A R P R A O K T
I H O E K I T P M C O A
A A N R U H E E N S R M
O R O M A R T I M E B E
T B T A S S Z N I L I H
O N W N K I P T I E T T
M E E Y M O N O R T S A
E E N I H P L O D U R M

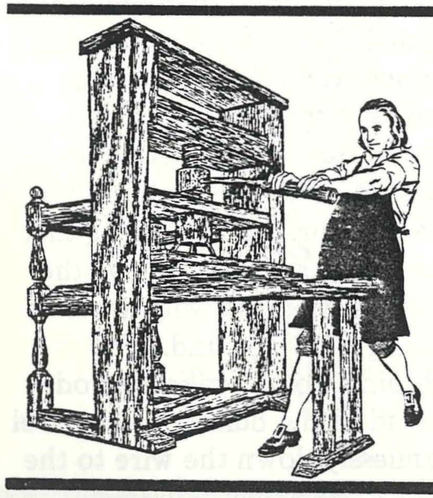
_____ 1. Last name of man called the founder of astronomy.
_____ 2. Tycho _____ helped Kepler.
_____ 3. City Kepler went to when religious problems became great.
_____ 4. Kepler taught this subject.
_____ 5. Young Kepler earned _____ so he could continue school.
_____ 6. Country in which Kepler was born.
_____ 7. Subject Kepler loved and studied.
_____ 8. Religious problems occurred in this city.
_____ 9. Brahe and Kepler worked on the _____ tables.
_____ 10. Many believed this was the center of the universe.
_____ 11. After leaving Prague, Kepler taught here.
_____ 12. Kepler was one of the first to discover the theory behind the _____.
_____ 13. In Kepler's laws he left out the _____ because he thought that the sun destroyed them.
_____ 14. Sir Isaac _____ was aided by Kepler's laws.
_____ 15. Kepler wanted to find out more about the _____ of the planets.
_____ 16. Kepler attended the University of _____.
_____ 17. Brahe left his _____ to Kepler when he died.

Benjamin Franklin

One of the outstanding thinkers of the colonial period in America was Benjamin Franklin. This man could have been great at just about anything he chose to do. Americans, when they study Benjamin Franklin, tend to focus on his political life. His ideas and actions did so much toward making the British colonies into the United States that we tend to forget the other side of this amazing man.

Ben Franklin was born in *Boston, Massachusetts*, on January 17, 1706. He came from a family of seventeen children. Since Ben was one of the youngest, he was apprenticed to one of his older brothers while he was still young. Ben only had two years of formal education, but this did not stop his quest for learning.

Ben became a *printer* and



then a writer. He picked up a following for his newspaper articles. Then he branched into politics and into diplomacy. Finally he became a scientist! It was Ben's desire to know as much as possible about the world that drew him to science.

Franklin began to invent things. He improved upon the *stove*. He created a new one called the Franklin stove. Next, he worked with glasses. Franklin wore glasses and it was always hard to manage two pairs—one for reading and close work, and one for other activities. He invented the *bifocal* lens. This included two different lenses put together, one for reading and one for regular viewing, in the same pair of glasses.

It was in the field of *electricity* that Franklin achieved the greatest results. *Static* electricity had been discovered and could

be stored in a metal-lined glass *jar*. A rod inserted through a cork that was stuck in the jar would shock anyone putting a hand near it. If the jar was placed near metal, a spark would leap across the air gap to the metal.

Many scientists experimented with these jars, and Franklin was one of them. He wondered if the spark that leaped across the air gap could be miniature lightning. Franklin decided to attempt an experiment. He is well-remembered for this experiment. He flew a *kite* in a thunderstorm. The kite had a pointed wire to which Franklin had tied a silk thread that could be charged by the electricity from the storm.

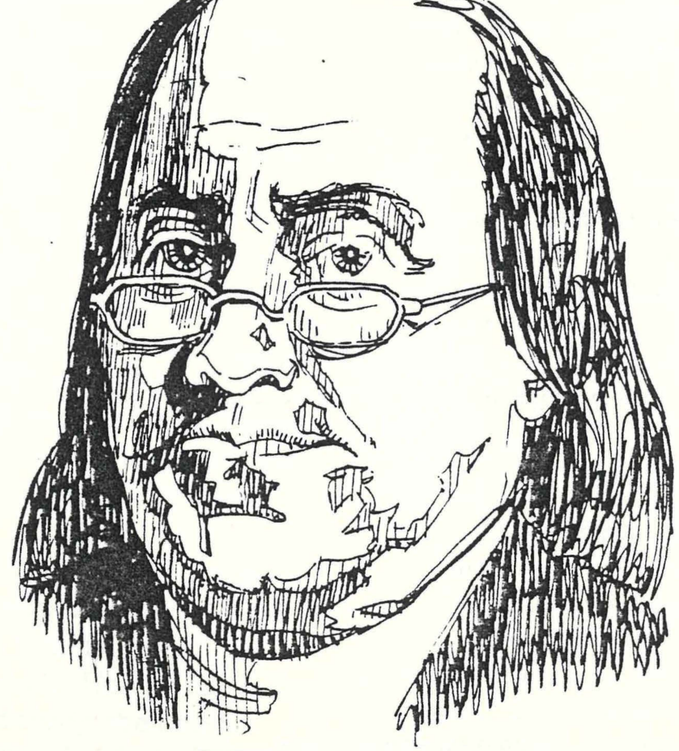
The storm got worse and lightning flashed. Franklin had tied a metal *key* to the silk thread. He put his hand near the key and received a shock, as he would have from the jar with the metal rod. Next Franklin charged the jar with static electricity from the storm.

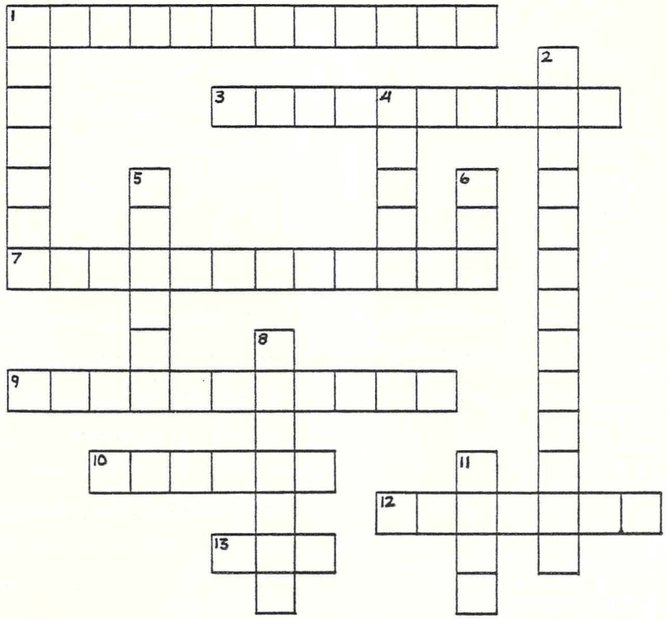
Franklin's report of the experiment caused excitement in the scientific world. He was made a member of the *Royal Society*. Franklin had been extremely lucky with his experiment. The next two people who tried to copy the experiment were killed by the electricity.

Franklin's experiments continued. He found that *pointed* surfaces caused the jar to discharge or spark easier. The pointed surface seemed to attract electricity. Franklin took this idea further, suggesting that metal rods be placed above the roofs of buildings, with wires leading to the ground. The lightning would strike the rod instead of the building and travel harmlessly down the wire to the earth. These lightning rods would protect the buildings from getting struck by lightning and burning. This idea was accepted, and the people of *Philadelphia* put lightning rods on many of their buildings.

Benjamin Franklin continued to explore his interest in electricity. He also became interested in the course of storms over the North American continent. He was the first to study the moving warm water belt in the North Atlantic Ocean. Today we call this warm water belt the *Gulf Stream*.

Franklin died in Philadelphia, Pennsylvania, on April 17, 1790. He is remembered most by Americans as being one of our founding fathers. However, as we have seen, he was also a scientist who helped explain the world around us.





ACROSS

1. City in which Franklin died.
3. Belt of warm water in the Atlantic Ocean.
7. Franklin was made a member of the _____ _____.
9. Franklin experimented with _____.
10. City in which Franklin was born.
12. Franklin found that _____ rods attracted electricity.
13. Electricity could be stored in a metal-lined glass _____.

DOWN

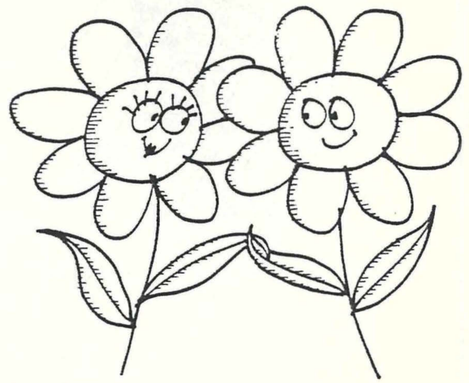
1. Franklin first became a _____.
2. State in which Franklin was born.
4. Franklin improved the _____.
5. _____ electricity could be stored.
6. Franklin tied a _____ to a silk thread.
8. Franklin invented the _____ lens.
11. Franklin performed a famous experiment with a _____.

Carl Linnaeus

Carl Linnaeus was born in *Rashult* in southern *Sweden* on May 23, 1707. Carl's father was a minister who wanted great things for his son. Carl seemed rather dull-witted at times, but his father insisted that Carl go to school to become a ***doctor***. Carl attended medical school at Lund and then at *Uppsala*. He managed to sharpen his mind and did well in school.

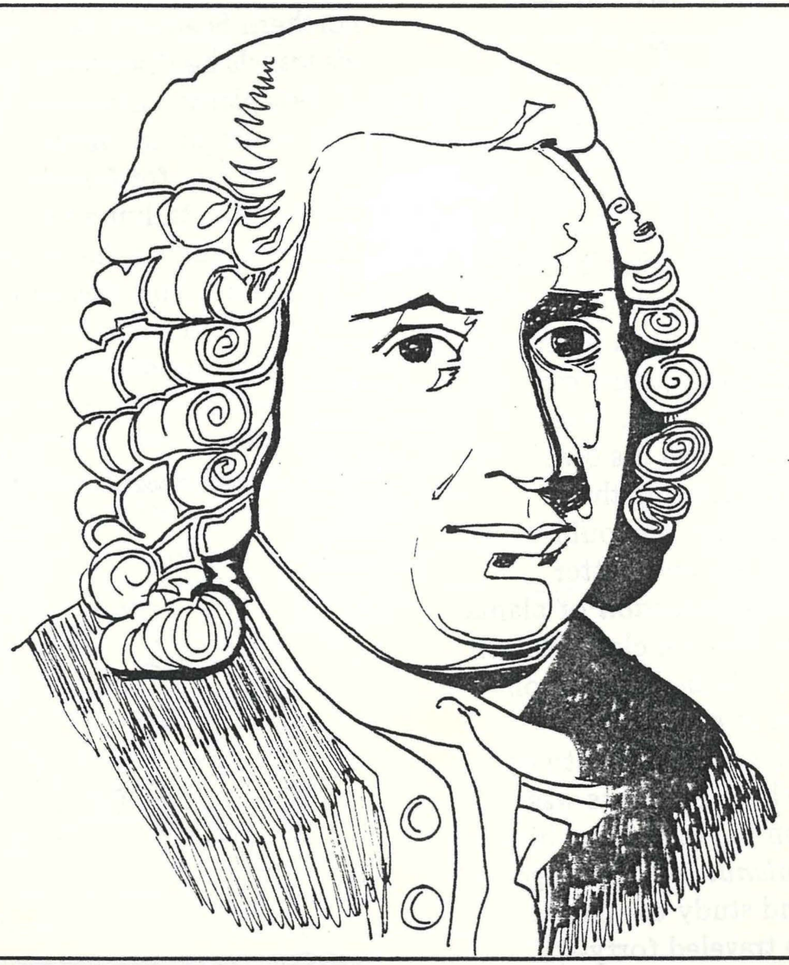
As a child, Carl had been interested in ***botany***, which is the study of ***plants***. He was able to enlarge his interest in college. He studied stamens and pistils in plants. This study led him to write a paper on the subject. While he was gathering information for his paper, Linnaeus became frustrated. Each scientist who worked with plants gave them different names. Each one, it seemed, had his own method of classifying them. Linnaeus felt that he could introduce a new and better method of ***classification*** of plants. His new idea on the classification of plants would be based upon their sexual organs.

In 1732 the University of Uppsala, where Linnaeus was lecturing on botany, asked him to visit ***Lapland***. He was to go to Lapland and study the native plants. He traveled forty-six hundred miles throughout northern Scandinavia. During his travels he discovered hundreds of new plants. Linnaeus was the first to use the *symbols* ♂ for male and ♀ for female. In addition to studying plants, Linnaeus studied the geography of Lapland. This was an unsettled area, and when he wrote about his travels it did much to make the area better known.



Linnaeus followed this trip with another trip. He traveled through England and western Europe. Again he catalogued many plants. In 1735 he published Systema Naturae. In this book Linnaeus established the classification of living things in a logical way. He developed a clear style of describing species. He pointed out exactly how each species is different from others. The next thing he did was to give each plant two names. The first name was for the group to which it belonged. The second name was special, just for that kind of plant.

Linnaeus loved his new classification system. He began to classify everything. The next step in his classification system

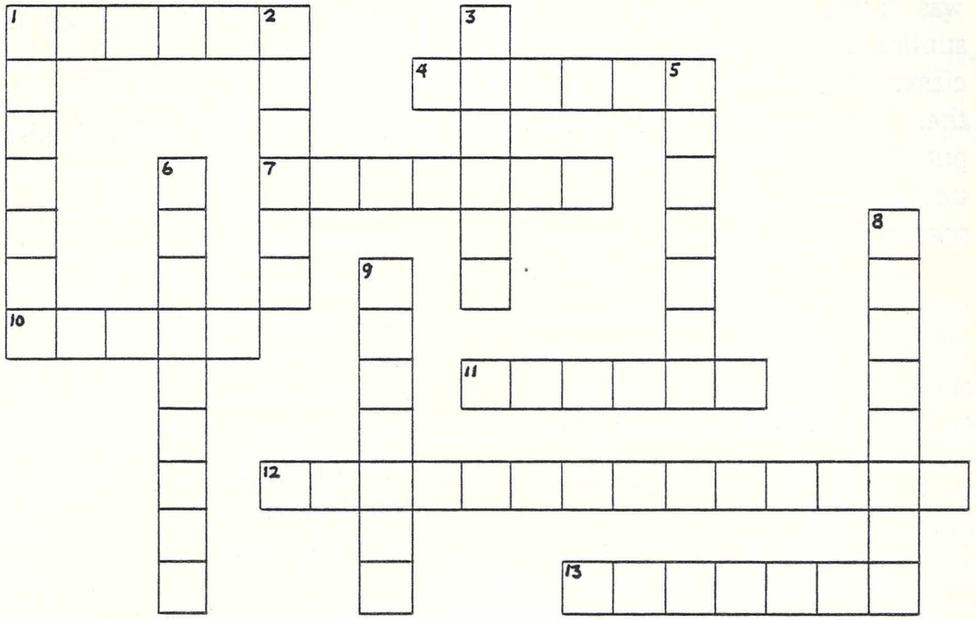


was to put related groups into a similar class. Then he took the classes that were alike and put them into orders. Linnaeus even put humans into his classification system. He gave the human species the name Homo sapiens.

While in Europe, Linnaeus met George *Clifford*. Clifford was a wealthy banker in *Amsterdam*. Clifford hired Linneaus to be his doctor and to classify the plants and animals on the Clifford estate. The stay on the Clifford estate gave Linneaus time to complete manuscripts that he had been working on.

When Linnaeus finally returned to Sweden, he entered medical practice. In 1741 he was appointed to the chair of medicine at Uppsala. Linnaeus was still more interested in botany than he was in medicine. A year after he received the chair of medicine he changed it for the chair of botany. This meant that he would be teaching botany instead of medicine, which made him much happier. Linnaeus spent the rest of his life teaching botany. He interested many students in the subject. Many of his students became so involved that they went throughout the world studying plants and classifying them as Linnaeus had done.

Linnaeus became famous during his lifetime. He was appointed to the Swedish House of *Nobles*. He died in Uppsala in January, 1778. A rich English naturalist, Sir J. E. *Smith*, bought Linnaeus's books and plant collections after his death. Smith took these to *England* where they were used as a basis for the Linnaean Society. Linnaeus brought standard terms and names to the study of biology. Without his methods, biology would be much harder to study and understand.



ACROSS

1. Linnaeus was born in this country.
4. Carl's father wanted him to be a _____.
7. Linnaeus traveled forty-six hundred miles through this area.
10. J. E. _____ bought Linnaeus's papers after his death.
11. When he was young, Linnaeus was interested in _____.
12. Linnaeus worked out a _____ system for biology.
13. Most of Linnaeus's writings were taken to this country.

DOWN

1. Linnaeus first used _____ for male and female.
2. Linnaeus was appointed to the House of _____.
3. The study of plants is called _____.
5. Town in which Linnaeus was born.
6. Clifford was from this city.
8. George _____ wanted Linnaeus to classify the plants on his estate.
9. Linnaeus taught at the University of _____.

Henry Cavendish

Henry Cavendish was born in *Nice, France*, on October 10, 1731. His mother was in poor health and had gone to Nice to get better. The weather in southern France helped some, but not enough. She died when Henry was only two years old.

Henry was reared in *England* and went to school there. He was different from the other students. He was not religious and refused to go to religious exercises. Because of this, he was not graduated from *Cambridge* University. Henry was strange in another way, too. He was extremely *shy* and almost afraid of people. In order to get his degree, he had to be examined by his professors. But he refused to meet them. This was another reason why he did not graduate.

Cavendish was unusual in other ways. He was absent-minded. He forgot simple things. He almost never spoke, but when he did he had a stammer. He would talk to only one man at a time and only if he had to do so. He never talked to *women*! He refused even to look at women. He wrote notes to his female servants so he didn't have to talk to or see them. When he met one of his female servants on the stairs by mistake, he fired her right away. He even had a separate entrance built so people wouldn't bother him.

Cavendish did not have to work for a living. He was left money from his father when his father died. Since Cavendish did not marry and spent little money, he had more than he needed. When Henry died, the fortune went to other heirs in the family.

Cavendish had one love that lasted sixty years. It was scientific research for itself alone. He didn't care if anyone knew of his work, or if his work was ever published. He simply wanted to know the answers himself. Because of this, much of his work was not discovered until after he died.

One of the things Cavendish was most interested in was *electricity*. He experimented with it widely, but did not publish what he found. He had no knack for invention, so he had to test the

strength of electric currents by direct contact. He would shock himself to gauge the strength of the current in his experiments.

Cavendish was also interested in gases. He worked with the *gas* that would be named hydrogen by Lavoisier, a French scientist, about twenty years later. Cavendish worked with this gas, finding out much about it, such as how things reacted in hydrogen. He measured hydrogen's density and found that it was very light. It had only one-fourteenth the density of air.

Hydrogen, Cavendish found, produced water when it was burned. This proved that water was a combination of two gases. He also passed electric sparks through air. Carrying this last experiment further, he ended up producing *nitric* acid. He also discovered a gas we now call argon. He did not know what this last gas was. It wasn't for another hundred years that argon was again found and identified.

Cavendish's most spectacular experiment was with the earth. The law of *gravity* had been worked out by Sir Isaac *Newton*. However, the *mass* of the earth had not been measured and could not be measured without knowing the gravitational attraction between two bodies. The trick was

to figure a way to measure this extremely weak gravitational pull.

Cavendish figured out a way. He suspended a light rod by a wire attached to its center. At each end of the rod was a light lead ball. The rod could twist freely about the wire. Next he put two large balls near the two light balls. The force of gravity between the balls caused the wire to twist. From the extent of the twist, Cavendish calculated the gravitational force between the pairs of balls. With this information he could figure out the parts of Newton's law of gravity and work out the mass of the earth.

Henry Cavendish died all alone in his home in *London* on March 10, 1810. We owe much of our knowledge of this strange man to Clerk *Maxwell*, a physicist. Maxwell edited Cavendish's manuscripts and published his works.

Despite his odd nature, he was thought of by the people living at the time as brilliant. He was probably the greatest scientist of his day.

C	N	I	C	E	C	N	A	R	F	D
G	O	N	O	T	W	E	N	E	W	N
R	N	I	L	L	E	W	X	A	M	A
A	E	T	N	O	D	N	O	L	A	L
V	M	R	X	S	A	G	Y	H	S	G
I	O	I	Y	R	N	E	H	Y	S	N
T	W	C	A	M	B	R	I	D	G	E
Y	T	I	C	I	R	T	C	E	L	E

_____ 1. City in which Cavendish was born.

_____ 2. Sir Isaac _____.

_____ 3. First name of Cavendish.

_____ 4. Country in which Cavendish lived.

_____ 5. Cavendish never spoke to _____.

_____ 6. Cavendish experimented with _____ even though he could not measure its strength.

_____ 7. Cavendish figured out how to measure earth's _____.

_____ 8. University attended by Cavendish.

_____ 9. Cavendish was extremely _____.

_____ 10. Hydrogen is a _____.

_____ 11. Clerk _____ edited Cavendish's papers.

_____ 12. Cavendish died in this city.

_____ 13. Cavendish worked with the force of _____ .

_____ 14. Cavendish once experimented and ended with _____ acid.

_____ 15. Country in which Cavendish was born.

Benjamin Banneker

Benjamin Banneker was born in *Baltimore, Maryland*, in 1731. He was unusual. He was a *Negro* living in a state that allowed slavery, but he was free. Conditions were difficult for the Bannekers. They were *tobacco* farmers who raised a good crop. However, at times they were not accepted because they were neither *slaves* nor free white people.

When Benjamin reached school age, it was decided that he should attend school. It was a small school, but there Benjamin learned to read. Benjamin read everything he could get his hands on. He began to give himself an education. It was soon time for Benjamin to help around the farm. His father was not able to run the farm without help. Benjamin hated to leave school but he had to do so. He continued to educate himself as he had time.

Ben also began to *experiment* with things. He used his hands well and became skilled with the use of tools. One day Ben saw his first pocket watch. He became interested in the workings of the watch. He decided to try to build a large clock that would chime the hour. Benjamin borrowed the pocket watch and studied it carefully. He planned how he would build his clock. He carved larger pieces out of wood that looked just like the pieces in the pocket watch. When he finished, he had created the first wooden clock ever made in America.

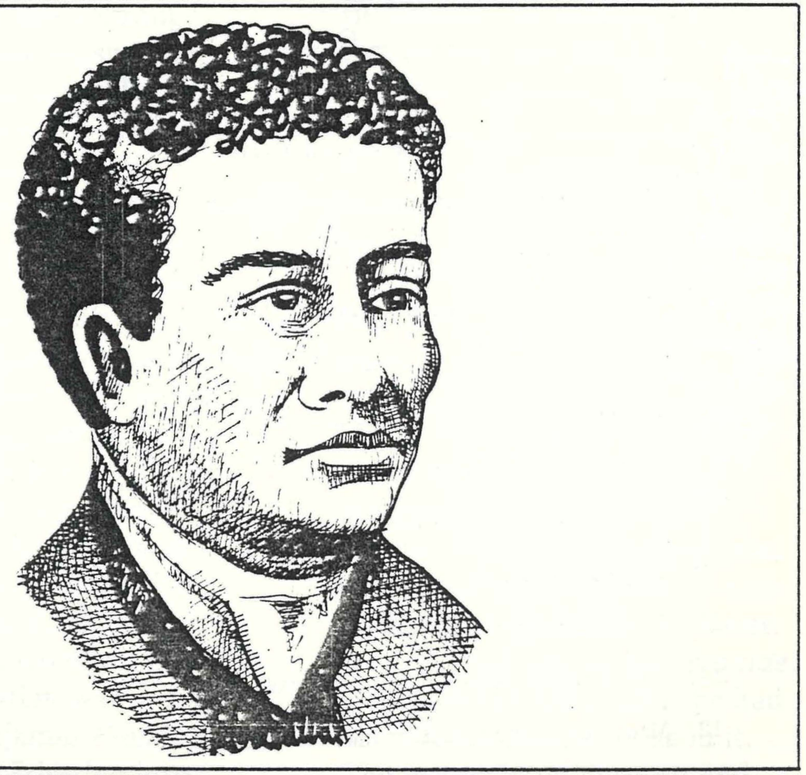
When Banneker's parents died, Ben got the farm. He really didn't want to be a farmer. He wanted to continue with his experimenting and studies. A new family named *Ellicott* moved into the area and became Banneker's friends. He helped them create their mill and forge. Eventually the Ellicotts took over Banneker's farm, paying Ben rent for the use of his land. This left him free to continue his learning and experimenting.

The Ellicotts were educated people and let Banneker use their books on mathematics and astronomy. He continued to study and soon became known as a genius. In 1791 Banneker published his first *almanac*. The almanac contained facts and information about the coming year. It even contained information about the weather.

Benjamin Banneker became even more well known. When it came time for the United States to have a *capital* city, he was asked to help *survey* the area. He was asked to help plan where the buildings and streets would go. Today our capital of *Washington, D.C.* shows the planning and skill of Benjamin Banneker.

Banneker's fame continued to grow. Men came from Europe to discuss things with him. He was regarded as a genius by all who worked with him.

Banneker also tried to help the Negroes in the United States who were slaves. He wanted everyone to be free and educated. He also wanted the world to be at *peace*. He thought wars were a waste and peace would advance the lives of the people of the world so much more. When he died in 1806, he had done much that contributed to his country.



1. E _ _ _ _ _ _ _
2. _ X _ _ _ _ _ _ _ _
3. P _ _ _ _
4. _ E _ _ _
5. _ _ R _ _ _
6. _ _ _ I _ _ _
7. M _ _ _ _ _ _ _
8. _ _ _ _ E _
9. _ _ _ _ N _ _
10. T _ _ _ _ _ _
11. _ _ _ _ I _ _ _ _
12. _ _ N _ _ _
13. _ _ _ _ _ _ G _ _ _

CLUES

1. The _____ family rented Banneker's land.
2. Banneker's _____ produced the first clock.
3. Banneker wanted _____ for the world.
4. Race to which Banneker belonged.
5. Banneker helped _____ streets.
6. Banneker helped build our _____ city.
7. State in which Banneker was born.
8. Negroes who were not free.
9. Banneker wrote an _____.
10. Crop grown by the Bannekers.
11. City in which Benjamin Banneker was born.
12. Many people thought Banneker was a _____.
13. Our capital is _____, D.C.

Joseph Priestley

Joseph Priestley was born in *England* on March 13, 1733. He was the son of a preacher. His father preached a new religion, and many people did not agree with his ideas. When Joseph was seven, his mother died. This was a blow for the boy because his father didn't have time to take care of him. Joseph's *aunt* stepped in and took Joseph to rear him. She did not follow Joseph's father's religion, but she was very religious. She made sure that Joseph was educated in religion as well as his other subjects.

Joseph was not a strong child. He had trouble speaking clearly and was often sick. He was a good student, though, and seemed to like to study. He studied languages, logic, and philosophy. He did not study *science*, and yet he later made a name for himself in this area.

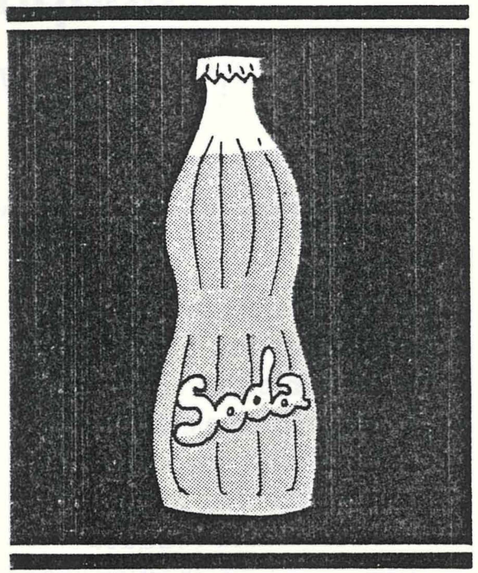
Priestley eventually became a Unitarian *minister*. He also became involved in politics, supporting the American colonies when they revolted against King George III. But he did not stop there. He also supported the *French* Revolution, which got him into serious trouble.

When Priestley was in *London* he met Benjamin *Franklin*. Franklin talked Priestley into taking up a career in science. Priestley moved to *Leeds* to become their minister. He began to do research on electricity under Franklin's encouragement. He became the first to find out that *carbon* would conduct electricity. He wrote an important history of electrical research in 1769. He predicted that electricity would be important to the field of chemistry.

In Leeds, Priestley lived next door to a *brewery*. He became fascinated with the *gas* given off as the grain fermented in the brewery. He began to study this gas. He found that it put out fire and that it was heavier than regular air. He also discovered that it dissolved a little bit when it was put in water.

The gas was carbon *dioxide*. He tasted the water after he had dissolved carbon dioxide in it. The water tasted pleasant and

refreshing. Today we call it *soda* water. Since soda pop needed only sugar and flavoring, Priestley might be called the father of the soft drink industry.



Priestley continued to be interested in gases. At the time Priestley began his study, only three gases were known — air, carbon dioxide, and hydrogen. He changed that. He isolated a number of different kinds of gases. His experiments earned him a reputation as a scientist. He was even invited to join the French Academy of Sciences.

In the process of working certain experiments, Priestley found a gas that encouraged burning. Materials that burn, when put in this gas, burned more brightly and quickly. When the French scientist, *Lavoisier*, destroyed the phlogiston theory,* he was able to realize that this gas was unusual. Lavoisier named Priestley's new gas *oxygen*. Priestley is still given credit for its discovery, even though Lavoisier gave it its present name.

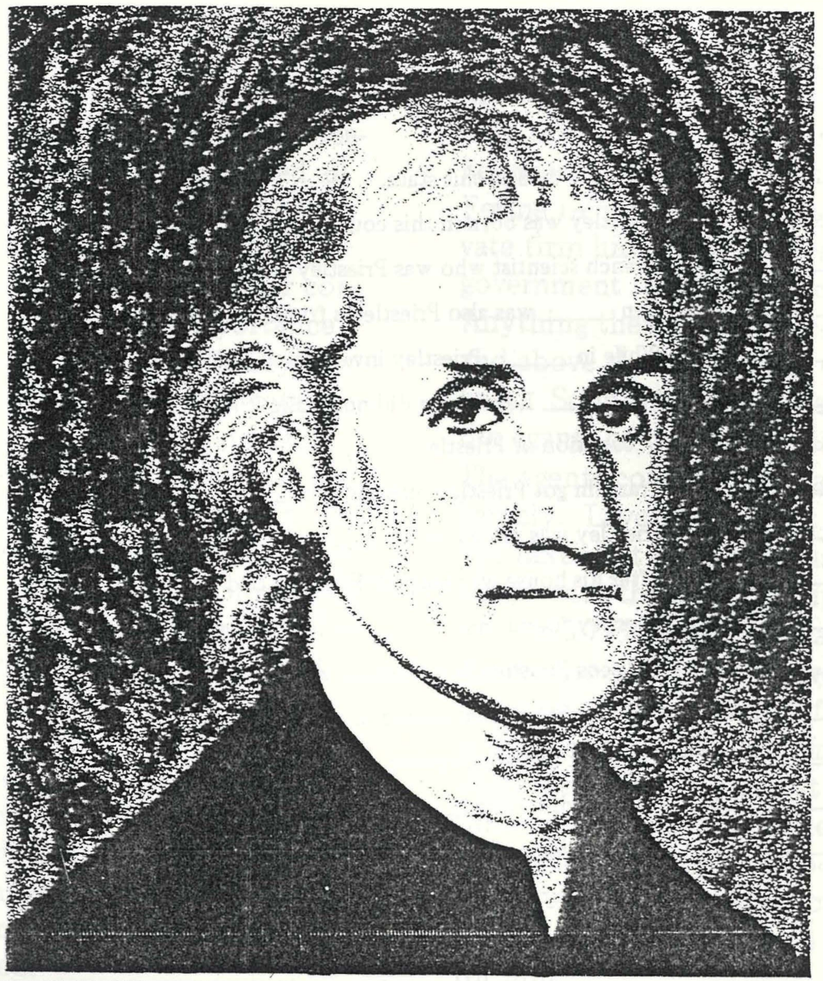
Priestley continued to experiment with oxygen. He found that mice became extremely active when breathing it. He tried it on himself and recorded his feelings of ease and lightness. He found that plants give off oxygen for people and animals to use.

Priestley also gave the name *rubber* to the sap of a South American tree. He had worked with it and found that it erased pencil marks if they were rubbed with it.

The French Revolution began, and Priestley was interested in its success. Since Priestly was not particularly well-liked, this caused more trouble. The people of his town began to look at him with suspicion. He tried to get more English people to support the French Revolution. A mob struck back by burning Priestley's house. Priestley was forced to flee to London. The people of London didn't care for him either. When the French cut off the head of Louis XVI, Priestley's ideas were even more suspicious.

Finally, Priestly was forced to leave England altogether. He came to America and his friend Benjamin Franklin. He was welcomed here because the new United States did not like England, but liked France. Priestley lived the last ten years of his life in the United States. He found peace here and was able to spend time with his writings. He died in *Pennsylvania* in 1804.

*It was once believed that materials that burn must be rich in a certain chemical, called "Phlogiston."



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U	E	L	O	N	D	O	N	Y	R	G	E
N	O	N	A	F	A	D	O	S	E	M	N
T	Y	X	G	V	R	Y	G	E	B	I	N
N	R	L	A	L	O	E	X	N	B	N	E
O	E	E	S	X	A	I	N	O	U	I	G
B	W	E	N	E	I	N	S	C	R	S	Y
R	E	D	I	X	O	I	D	I	H	T	X
A	R	S	C	I	E	N	C	E	E	E	O
C	B	O	X	N	I	L	K	N	A	R	F

_____ 1. Priestley died in this state.

_____ 2. Priestley was born in this country.

_____ 3. French scientist who was Priestley's friend.

_____ 4. Ben _____ was also Priestley's friend.

_____ 5. While in _____, Priestley investigated electricity.

_____ 6. The _____ Revolution did not make Priestley popular.

_____ 7. Occupation of Priestley.

_____ 8. Franklin got Priestley interested in _____.

_____ 9. Priestley was reared by his _____.

_____ 10. After his house was burned, Priestley fled to _____.

_____ 11. Priestley found that _____ would conduct electricity.

_____ 12. In Leeds Priestley lived next to a _____.

_____ 13. Priestley became interested in studying _____.

_____ 14. When put in water, carbon _____ tasted good.

_____ 15. Priestley discovered _____ water.

_____ 16. Lavoisier named Priestley's new gas _____.

_____ 17. Priestley named the tree sap _____.

Antoine Lavoisier

Antoine Lavoisier was born in *Paris, France,* on August 26, 1743. He was born to a well-to-do family and was spoiled as a young man. He suffered stomach problems, which caused him to devote his time to his studies rather than the more rough play of many boys. He became a brilliant student. He attended Collége *Mazarin* where he grew interested in *chemistry*.

Lavoisier was unusual in his approach to chemistry. He saw the importance of accurate *measurement*. Before this time, measurement was not considered all that important. Scientists observed and wrote their findings from observation. Lavoisier continued to stress the importance of measurement, and finally others agreed. This idea totally changed the field of chemistry.

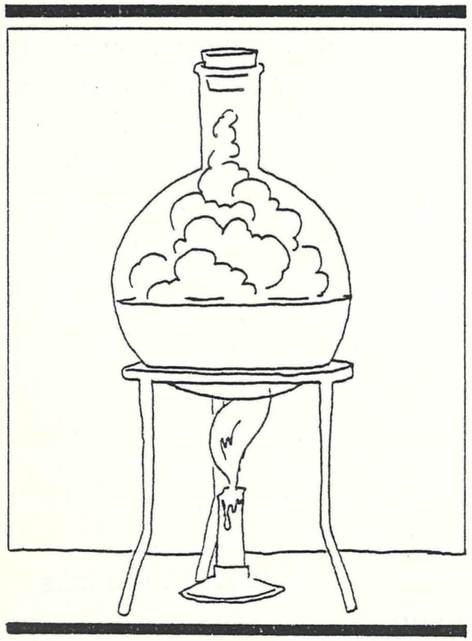
Lavoisier did more than sit around measuring chemicals. He worked to better the lives of the people. He worked on improved methods of lighting towns so there would be less crimes and people could see where they were going. Another field Lavoisier entered was *agriculture*. He wanted to improve farming methods in France. He established an experimental station or *farm* on which his ideas could be practiced.

Lavoisier was to make two mistakes in his life that would help bring on his death. In 1768 he invested some money in the Ferme *Générale*. This was a private firm hired by the French government to collect *taxes*. Anything they could collect over and above the taxes, they could keep. Soon the farmers hated the agents of the Ferme Générale. The agents collected the taxes harshly. Lavoisier did not collect taxes but he became associated with the hated group.

In 1771, Lavoisier married *Marie*-Anne Paulze. She was the daughter of an important figure in the Ferme Générale. Marie-Anne was only fourteen at the time. She began to help her husband with his work and took notes, translated things from English, and illustrated his books for him.

Lavoisier's second mistake came in 1780. Lavoisier had been elected to the French *Academy* of Science. In 1780, Jean-Paul *Marat* applied for membership to the academy. Marat was a writer who also thought he was a scientist. Lavoisier did not agree. Lavoisier worked against Marat, and he was not accepted into the academy. Marat eventually brought about Lavoisier's death because of this action.

Lavoisier began to work on an old *Greek* theory that *water* could be turned to *earth* if heated long enough. Lavoisier decided to test the theory. He measured both the water and the vessel. He boiled the water for one hundred and one days in a vessel that condensed the water so none was lost. Sediment appeared, but the water did not change weight! The vessel had lost weight, however. The sediment just made up the vessel's weight loss. He had disproved the Greek theory.



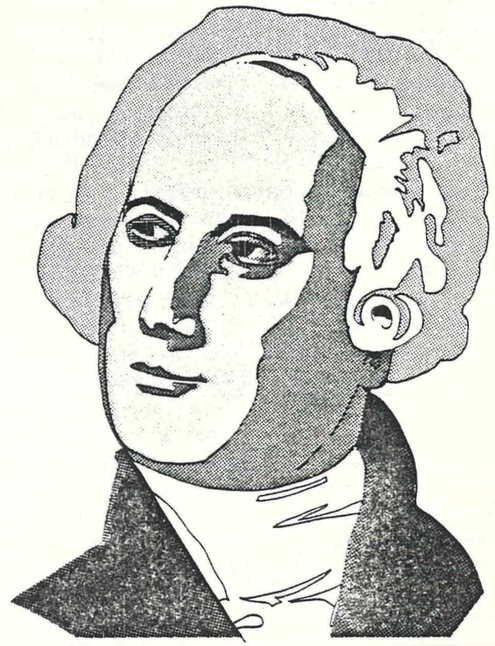
Lavoisier went on to experiment with the *phlogiston* theory. Again he measured the elements in his experiment carefully. When he was through, he had disproven the phlogiston theory as well. News of his experiments traveled among scientists. His methods helped establish chemistry on a modern basis.

In 1778 Lavoisier announced that air consisted of two gases, one of which supported combustion and one that didn't. The one that supported fire he named *oxygen*. The other he called *azote*, which was renamed *nitrogen*. *Priestley*, another scientist, had helped Lavoisier, but Lavoisier tried to give the impression that he alone had discovered oxygen.

Lavoisier continued his experiments, becoming known as the Father of Chemistry. He also developed a reputation as a credit snatcher. He read the work of a Russian chemist, *Lomonosov*, and may have "borrowed" some of his ideas, as he had done with Priestley.

The new ideas of chemistry began to catch on. There were some who still believed in the phlogiston theory, but many began to follow Lavoisier's lead. At this time Guyton de Morveau ran into trouble writing an article for an encyclopedia. He turned to Lavoisier for help. Lavoisier decided the trouble was the language. Each scientist had used his own words for his experiments, and many times another scientist repeated the experiment with another set of words. This made the literature and history of chemistry hard to read and understand. Lavoisier went to work to give chemistry a common *language*. He published a *book, Methods of Chemical Nomenclature*, that told scientists how to name their new substances. He said the name should be based on the elements of which it is composed. This made so much sense that most scientists began to follow this practice.

Lavoisier went on to publish a textbook on chemistry that was used by many people. This same year the French *Revolution* broke out, and the poor people fought against the wealthy. Lavoisier was arrested because of his connection with the Ferme Générale. Marat had become very important in the Revolution, and he remembered Lavoisier keeping him out of the Academy. Marat got his revenge. Lavoisier was taken to trial and was found guilty. He was put to death. But the Revolution could not erase what Lavoisier had done in chemistry.



T N E M E R U S A E M R A F I
V A E G A U G N A L A Y X O N
A G X E N I O T N A Z O T E O
N E N E G Y X O F R A N C E T
P R I E S T L E Y E R I K Y S
R E V O L U T I O N I T O M I
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T A R A M Y R T S I M E H C H
T L O M O N O S O V I N E A P

_____ 1. Lavoisier's first name.
_____ 2. Lavoisier wrote a _____ on the *Methods of Chemical Nomenclature.*
_____ 3. This man helped Lavoisier with the discovery of oxygen.
_____ 4. Lavoisier became the "Father of _____."
_____ 5. Lavoisier attended Collége _____.
_____ 6. Many people felt _____ could be turned to earth.
_____ 7. Jean-Paul _____ became Lavoisier's enemy.
_____ 8. Lavoisier was executed during the French _____.
_____ 9. One of the problems with chemistry was the _____ used by the scientists when they wrote.
_____ 10. This gas supported fire.
_____ 11. Lavoiser named the gas that would not support fire _____.
_____ 12. Many felt water could be turned to _____ with enough heat.
_____ 13. Lavoisier married _____ -Anne.
_____ 14. The Ferme _____ became hated by the farmers.
_____ 15. Lavoisier was born in this country.
_____ 16. Lavoisier became convinced that exact _____ would make a difference in chemistry.
_____ 17. In this gas, fire will not burn.
_____ 18. Lavoisier may have borrowed this Russian's ideas.
_____ 19. Lavoisier disproved this famous theory.
_____ 20. Lavoisier was invited to join the French _____ of Sciences.
_____ 21. City in which Lavoisier was born.
_____ 22. Lavoisier had new ideas in _____ that would help people farm better.
_____ 23. _____ were collected by a private firm.
_____ 24. Lavoisier practiced some of his ideas on an experimental _____.
_____ 25. Lavoisier decided to test an old _____ theory.

Edward Jenner

Edward Jenner was born in Berkley, *England*, on May 17, 1749. Jenner was the son of a clergyman. Edward's father apprenticed him to a surgeon after his basic education. This went well for Edward, but he did not have the skill, as of yet, to become a *doctor*. From 1770 to 1772 Edward studied with John *Hunter* in *London*. Again Jenner learned many things, especially about the construction of the body. Jenner also studied at St. George's Hospital in London. He was given his medical degree from the University of St. Andrew in 1792.

Jenner had other interests. One of these was in natural history. Jenner was so skilled in natural history that he was given the job of preparing and arranging the specimens Captain *Cook* collected on his first trip to the *Pacific*. He was even offered a job on the second voyage, but preferred to stay at home to practice medicine.

Jenner's chief interest in medicine was *smallpox*. Almost everyone got smallpox at one time or another. When a smallpox epidemic hit, they could expect one in three cases to die. Those who were lucky enough to live were terribly *scarred*. Most people feared the scars of recovery worse than they did death.

A light case of smallpox was desired, however. If you got a light case you were *immune* to all future attacks of the disease. In *China* there was an attempt to give a person a light case of smallpox by infecting that person from someone who already had the disease. But this was taking a chance. Many times the case was a light one, but there was no way to tell definitely. Some people died from taking this chance.

Jenner began to investigate an "old wives' tale." This tale said that anyone who caught *cowpox*, a mild disease of cattle resembling smallpox, would be immune to both cowpox and smallpox. Jenner wondered if this story was true. There was only one way to test the story. Jenner found a milkmaid who

had cowpox. He took fluid from a blister on her hand and infected it into a boy. The boy got cowpox. Two months later Jenner infected the same boy with smallpox. If the boy got smallpox, Jenner's idea would be proven wrong. He would have been branded a criminal and not allowed to practice medicine. The boy did not get sick; he did not die; Jenner's experiment was a success.

Still Jenner wanted to make sure he was correct. He wanted to try the experiment again. It took him two years to find another case of cowpox. He repeated his experiment, and again it was successful. The patient got cowpox, but not smallpox.

Jenner wrote up his experiment in Latin. The Latin word for cow is *vacca*. Jenner made up the word *vaccination* to describe his use of cowpox to create immunity to smallpox.

The people of the world were so afraid of smallpox that they accepted Jenner's vaccination idea willingly. The British Parliament even voted to give Jenner ten thousand pounds in 1802 and twenty thousand pounds in 1807. In eighteen months twelve thousand people were vaccinated in England, and the death rate dropped by two-thirds. The people of the world thought of Jenner as a hero. Many countries honored him. The doctors in England, however, were slow to recognize him.

The doctors of England wanted to examine Jenner on the classic theories of Hippocrates and Galen before he could be elected to the College of Physicians. Jenner thought he should be elected because he had conquered smallpox. The doctors disagreed. Jenner refused to be examined, so he was not elected to the College of Physicians.

Edward Jenner died in England on January 26, 1823. He was responsible for conquering smallpox. It was the only disease conquered until after *Louis* Pasteur had explained the cause of most diseases.

E R C O O K D R A W D E
N E O D E R R A C S L N
U T W X S I U O L X O G
M N P A N I H C T J N L
M U O P A C I F I C D A
I H X O P L L A M S O N
V A C C I N A T I O N D

_____ 1. Jenner's first name.

_____ 2. Country in which Jenner worked.

_____ 3. Disease Jenner cured.

_____ 4. _____ Pasteur explained what caused most diseases.

_____ 5. Jenner's occupation.

_____ 6. Country that tried to give light cases of the disease.

_____ 7. This disease gave protection from smallpox.

_____ 8. Captain _____ was an explorer.

_____ 9. Jenner worked at St. George Hospital in this city.

_____ 10. Having protection against a disease meant you were _____ to it.

_____ 11. Those that lived after having smallpox were _____.

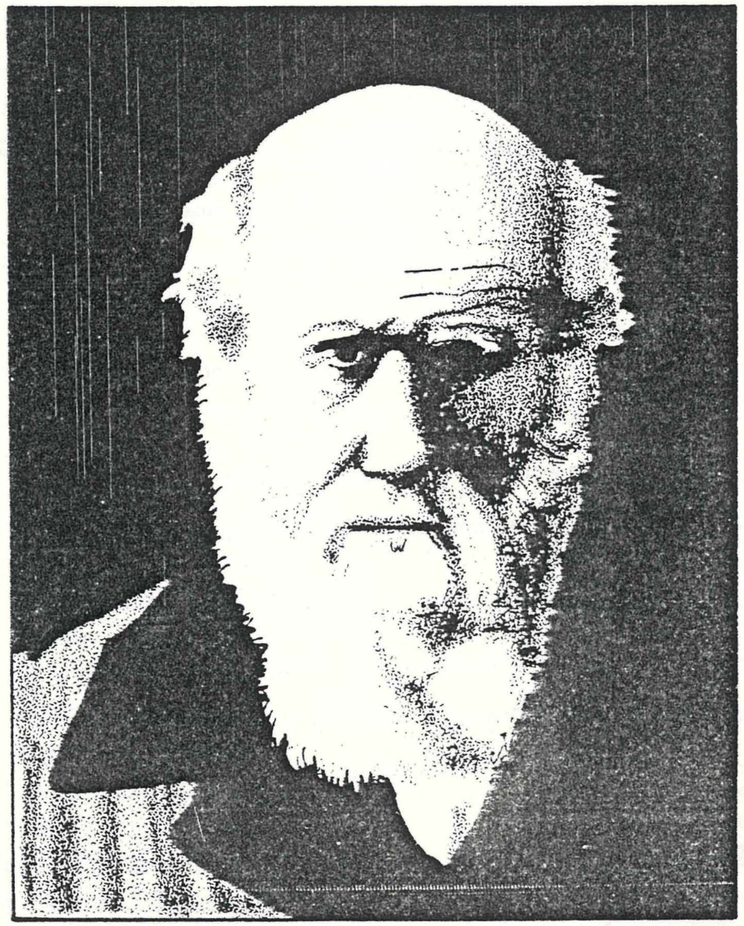
_____ 12. Jenner made up this word to describe his idea.

_____ 13. Cook brought back specimens from this area.

_____ 14. Jenner studied with John _____.

Charles Darwin

Charles was going to be a disgrace, his father thought. His father was a successful physician. Even his grandfathers had been successful. Charles, however, was going to be a failure! First he had tried to be a doctor, like his father. This failed because Charles hated the sight of blood. Next, Charles tried to make a career in the Church. He failed at that, too.



The only thing that Charles seemed to do well was his hobby. His hobby was natural history. Charles had been born in Shrewsbury, *England*, on February 12, 1809. As a young man, he had read a book by Alexander *Humboldt*, the famous explorer. He became interested in Humboldt and natural history. When he went to *Cambridge* University, he studied more natural history.

Charles began to make a name for himself. His father still wasn't happy, but at least his son wasn't a complete failure.

In 1831, the H.M.S. *Beagle* was going on a voyage of exploration. Charles Darwin was asked to go along as a naturalist. It would be a five year cruise and Charles's father was against it. Charles, however, chose to go. This voyage made Darwin famous, but also caused him great suffering. Conditions on a cruise of this kind were hard, and the people endured much hardship. Nevertheless, this became one of the most important voyages in the history of biology.

Darwin kept notes on the animals encountered on the long voyage. Often he found an animal that looked like another animal, but with certain changes. Probably the best observations that Darwin made were during a five week stay on the *Galápagos Islands*. The Galápagos Islands were 650 miles off the coast of *Ecuador* in the Pacific Ocean. These islands contained many unusual animals that Europeans had never seen. The giant tortoises were especially interesting to the crew.

Darwin became fascinated with a group of birds now called "Darwin's *finches.*" Darwin discovered fourteen different species, not one of which was found on the South American continent nearby. As far as anyone knew, they were found nowhere else in the world. Darwin guessed that the finches had evolved, or

changed, throughout their existence on the island so that they were different from other finches.

The *Beagle* returned to England in 1836. Darwin wrote a book about the observations he had made. The book impressed Humboldt and others. Darwin's reputation was made.

Darwin was still concerned with the finches. He read Thomas *Malthus's* essay on population, which said that man increased faster than his food supply. Mankind would be cut down by starvation, disease, or war until the food supply could support the population. Darwin thought this had happened to the finches, forcing them to change and eat things other than what they had been used to. Their beaks had changed slowly so they would be better able to eat the new food.

Darwin began to work on his ideas of ***evolution***, or change, in the animal kingdom. He came up with the idea of ***natural*** selection. Under natural selection, when conditions became hard to survive, certain species changed or adapted to their new environment. Other species either died out or made different changes to survive.

Another of Darwin's ideas was that a female of a species deliberately chose the best male as her mate. Never did they choose a mate that was deformed or weak. Darwin said this was nature's way of making the species stronger.

Darwin worked and worked on his ideas. He was in no hurry to publish them. He wanted them perfect first. Another scientist, *Wallace*, wrote a paper using many of Darwin's ideas. This caused friends of Darwin to ask him to publish his ideas. He finally organized his theory and wrote it up. It had a long title but was simply known as *The Origin of the Species.*

Darwin's book became one of the classics of science. The book started violent arguments that have lasted for generations. Many people thought the book went against the teachings of the ***Bible***. They thought Darwin's ***Theory*** of Evolution was destructive to religion.

Darwin was not interested in fighting for his theory. He was a gentle man who hated arguments. Other scientists, however, joined Darwin and defended the Theory for Darwin. The world of science accepted Darwin's theory even if others did not.

Charles Darwin died in England, April 19, 1882, and was buried in *Westminster* Abbey with other English heroes.

R	E	T	S	N	I	M	T	S	E	W	S	W
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U	C	O	N	N	U	U	I	T	A	E	N	A
C	E	A	A	T	R	B	O	N	N	H	I	C
E	P	L	I	A	L	O	N	D	D	T	F	E
F	S	O	L	E	G	D	I	R	B	M	A	C
I	N	G	A	L	A	P	A	G	O	S	O	S
G	A	T	D	L	O	B	M	U	H	O	T	G

_____ 1. Darwin is buried in _____ Abbey.

_____ 2. The *Origin of the* _____.

_____ 3. Darwin visited these islands.

_____ 4. Birds named for Darwin.

_____ 5. Thomas _____ wrote about population expansion.

_____ 6. Many people believe Darwin's ideas go against the _____.

_____ 7. Country in which Darwin was born.

_____ 8. Alexander _____ influenced Darwin as a young man.

_____ 9. Darwin went to _____ University.

_____ 10. H.M.S. _____ went on a voyage of discovery.

_____ 11. The Galápagos Islands are off the coast of this country.

_____ 12. The change in a species through time is called _____.

_____ 13. _____ selection was one of Darwin's ideas.

_____ 14. Darwin had a _____ of evolution.

_____ 15. The other scientist who published some of Darwin's ideas.

_____ 16. The special birds were found on a group of _____s.

Maria Mitchell

Maria Mitchell was born on the island of *Nantucket* on August 1, 1818. At the time Maria was born, Nantucket was the center of the whaling industry. Most of the men were connected to this industry. Some were sailors, some captains, and others handled the oil after the ships came in. The whaling ships were out at sea for long periods of time. This meant that the women living on Nantucket had to handle their own problems and affairs more than other women did at the time. They therefore became more independent than other women.

Maria was like other women on Nantucket. She had unusual amounts of freedom and independence. She also belonged to the *Quaker* religion. This meant that her life was simple, and she cared more about what God thought of her than what other people thought.

Maria's father, *William*, was interested in *astronomy*. He used simple equipment to observe the sky. Maria became her father's special helper. She was good in arithmetic and was able to work out problems for her father. At first she learned to use her father's instruments to help him. Later, however, she used them because she loved astronomy, too.

The teachers of the Nantucket schools realized that Maria had great talent in *mathematics*. They helped her learn more advanced forms of mathematics, but soon she knew even more than they did. Still they encouraged her to learn more.

While Maria was still young, she was appointed *librarian*. This opened another world for her. There were books on mathematics for her to study. She also read the books they had on astronomy. Both Maria and her father became well known for their interests in astronomy. Because of this interest, they met many scientists from *Boston* and gained more knowledge.

In the evening Maria studied the sky with her father's *telescope*. She observed several comets and worked out their paths. In October, 1847, while she was studying the sky, she found something new! It was an unknown *comet*. Her father told the scientists in Boston what she had discovered. They, in turn, told astronomers in Europe, and soon Maria was famous. She received a gold medal from the King of *Denmark* for her discovery. She was also elected to many scientific societies because of it.

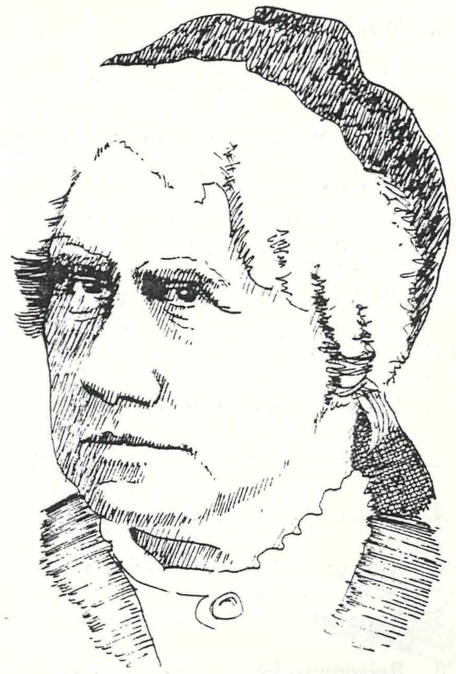
The women of America were proud of Maria Mitchell. They presented her with an excellent telescope. This telescope made her observations easier than they had been. Women's groups also pointed to her with pride, showing what could be done by other women with proper encouragement and education.

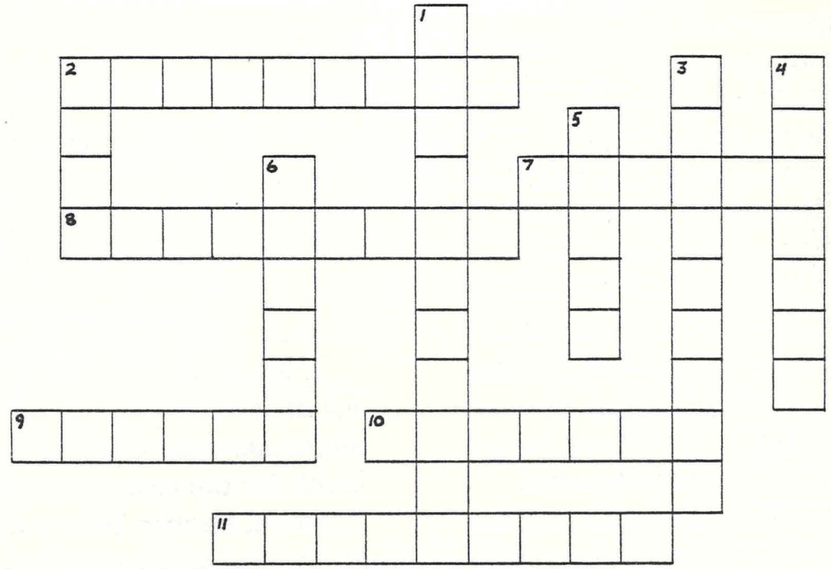
In 1857 Mitchell traveled to Europe to meet men of science. She also made observations and discussed astronomy while she was there.

In the United States, plans were made for a college of higher education for women. The college's founder, Matthew *Vassar,* surprised Mitchell. He asked her to become the first professor of astronomy! Mitchell wasn't sure. She had no training as a teacher. Her father and Matthew Vassar encouraged her, so she accepted. She became a professor of astronomy.

Mitchell was the only member of the faculty who was known in both America and in Europe. She was also an excellent teacher. Her students were greatly influenced by her. She not only helped them with astronomy, but also with life in general.

Maria Mitchell died at the age of seventy-one in *Lynn*, Massachusetts. She had done much for the role of women in America, besides having added knowledge to the scientific world.





ACROSS

2. While still young, Mitchell was appointed _____.
7. Mitchell and her father talked to scientists from this town.
8. Island on which Maria Mitchell was born.
9. Matthew _____ asked Mitchell to become a teacher.
10. Name of Maria's father.
11. Women gave Mitchell a _____.

DOWN

1. Maria's teachers knew she was good in _____.
2. City in which Mitchell died.
3. Subject Maria and her father liked.
4. King of _____ gave Mitchell a gold medal.
5. Maria Mitchell discovered a new _____.
6. Religion to which Mitchell belonged.

Gregor Johann Mendel

The little peasant boy was hungry, but he could not go home for food. There was little food at home. Besides, he had a job to do. He had to take care of the *fruit* trees for the lord of the manor. Sometimes, when he was very hungry, he ate some of the fruit from the trees. This happened rarely, however, for the lord would be angry at him and might have him beaten.

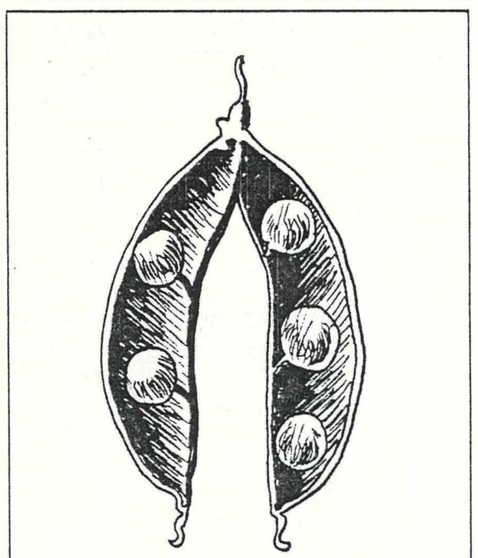
The peasant boy was *Johann* Mendel, who was born in the area we now call Czechoslovakia, on July 22, 1822. He had a hard time as a young child. His life changed when he entered the *Augustinian* Order in the Catholic Church. He took the name *Gregor* when he became a monk. He spent years studying until he became a *priest* at the age of twenty-five.

The Augustinian Order supplied the teachers for the Austrian schools. Because of this, Mendel was sent to the University of *Vienna*. He was to be trained in mathematics and science. Once he was trained, he became a teacher at the *Brunn* Realschule. He lived in the abbey of St. Thomas in Brunn.

Mendel had a strong interest in mathematics and in *botany*, which is the study of plants. Mendel was interested in plants

because of his early work taking care of the fruit trees. He combined his interest in the two fields and began his hobby, which was growing *peas* in the monastery garden.

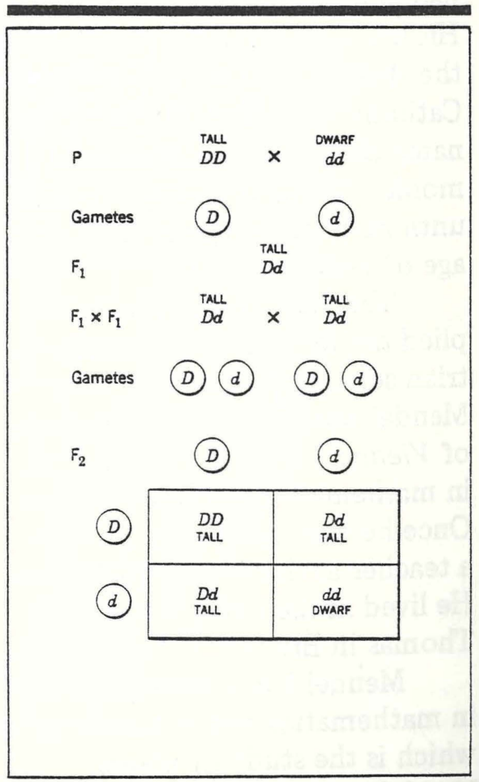
Mendel's hobby turned into research. He carefully hand-pollinated his different kinds of peas. To make sure that no bees pollinated the peas, he carefully wrapped the plants. If bees had gotten through the wrappings to help pollinate the peas, his results would not have been valid.



He saved the seeds from the pea plants, being sure to keep each variety isolated. The next year he planted his various kinds of peas separately, and studied the new pea plants that grew from his saved seeds.

He found that if he planted seeds from *dwarf* pea plants, only dwarf pea plants sprouted. When he saved their seed and grew it once more, again only dwarf pea plants came up. He concluded that dwarf pea plants would always make dwarf pea plants. He said they "bred true."

Mendel also worked with tall pea plants. He found that they did not "breed *true*." Sometimes the new plants would be tall, but sometimes they would produce dwarf plants.



Next Mendel cross-bred dwarf plants with tall plants. He found that the mixed plant that grew the next year was a tall one. This mixed plant was called a *hydrid*. The dwarfness seemed to have disappeared.

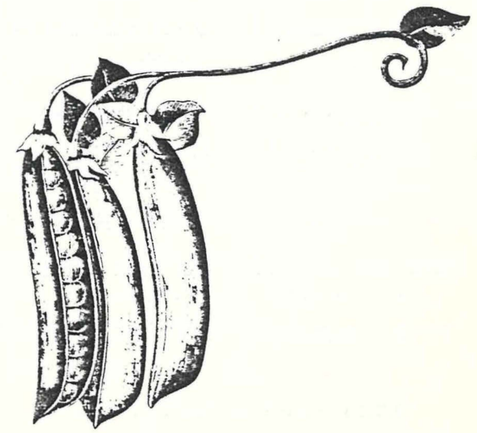
He worked on the hybrid plants and cross-bred them. He found about one-fourth became true-breeding dwarf plants. One-fourth became true-breeding tall plants, and one-half developed into non-true-breeding tall plants. The one-half contained the characteristics that could make both tall and dwarf plants.

Mendel continued his work with pea plants for eight years. He worked to understand their color as well as their size. He kept notes on the generations of his plants and how he had done his experiments.

He wrote a paper about his experiments and read it to a local natural history society. There were no questions from the group. They apparently were not impressed with Mendel's research. Mendel was upset. He thought he needed to have a known botanist examine his work. He wrote to Nageli, a well-known botanist, and sent him a copy of his paper. Nageli wasn't interested either! Mendel was hurt by this lack of interest. He wrote two papers on the subject and then let the research drop.

Mendel was made the head of a monastery in 1868. He realized he had no time to do any more research. Besides, no one seemed to care about the research he had already done. Mendel's work remained ignored. He died in 1884, lonely and sad. Nageli died in 1891, not knowing the mistake he had made.

It wasn't until 1900 that *DeVries* came across Mendel's results. DeVries brought them to the attention of the scientific world. They became known as the Mendelian laws of inheritance. Mendel finally achieved fame for the great work he had done.



N	A	I	N	I	T	S	U	G	U	A
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G	Y	A	E	N	A	N	N	E	I	V
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L	A	V	I	O	R	R	H	O	I	R
I	T	R	U	E	J	I	B	R	U	A
Y	O	P	O	D	S	A	E	P	R	W
H	B	D	I	R	B	Y	H	S	F	D

_____ 1. This man discovered Mendel's paper.

_____ 2. Mendel took this name when he became a monk.

_____ 3. Mendel went to the University of _____.

_____ 4. As a young boy Mendel worked with _____ trees.

_____ 5. Mendel joined the _____ Order.

_____ 6. Well known botanist.

_____ 7. Town in which Mendel worked.

_____ 8. Mendel became a _____.

_____ 9. If the offspring are always like the parent plant it is said to "breed _____."

_____ 10. Study of plants.

_____ 11. Mendel worked with _____.

_____ 12. Mendel's first name, which became his middle name.

_____ 13. The small plants that Mendel used were _____ plants.

_____ 14. Mendel called a mixed plant a _____.

Thomas Alva Edison

Thomas *Alva* Edison, born February 11, 1847, had many adventures as a young boy. He was curious about everything. He experimented with everything. Sometimes he got into real trouble because of this experimenting. When he was curious about how a hen hatched eggs, he tried to sit on them, too. They broke all over the seat of his pants.

His formal education ended after three months. His mother took him out of school and taught him herself. She made a game of teaching him. When Alva was nine, his mother got him a chemistry book. He tried out every experiment in the book!

At twelve the boy got a job as a "news butcher" on the Grand Trunk Railroad. He sold newspapers, candy, and sandwiches on the train. In his spare time he experimented with *chemicals* in the baggage car. One day a stick of phosphorus burst into flames and set the car on fire. The *conductor* boxed Alva's ears and threw him off the train.

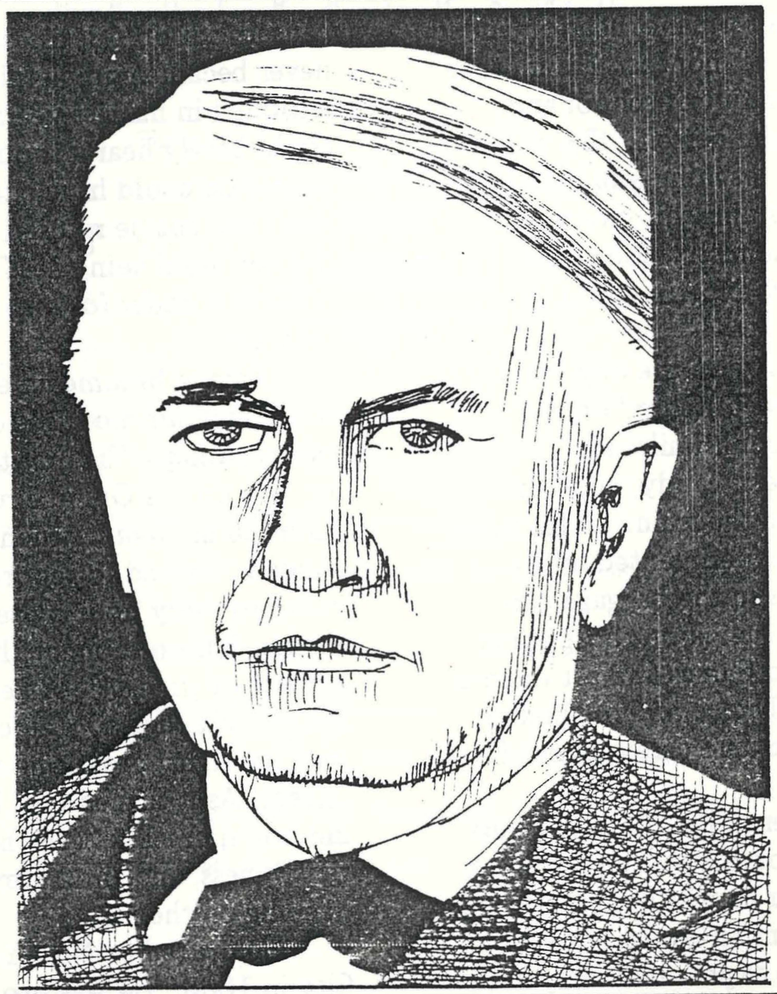
Later in his life Alva struggled to board a moving train. A conductor caught hold of his ears to pull him on board. One of these two experiences may have caused Edison's deafness. He never became completely *deaf*, although in his last years he could barely hear a shout. An operation could have cured his deafness, but he refused it. He did not mind being deaf because it made it easier for him to concentrate.

Edison became an expert at tapping out messages on the *telegraph* key. His first telegraph job was on the Grand Trunk Railroad in *Canada* when he was sixteen. He had to report to Toronto every hour by telegraph signal. Edison thought this was a waste of time. He rigged up a gadget, attached to a clock that sent the signal even if he was asleep. As it turned out, his boss did not appreciate Edison's inventiveness, and fired him for sleeping on the job.

He drifted to New York City in 1869. He was broke. He

got a job with the Gold Indicator Company. The company had a stock *ticker*, which was used to report the price of gold to brokers' offices. The ticker broke down. After other people had failed, Edison fixed it! He went on to invent many improvements in their telegraph equipment. The president of Gold and Stock Telegraph Company, Marshall *Lefferts*, became interested in buying Edison's inventions. Edison thought five thousand dollars would be a wonderful price, but asked Lefferts what he would pay for them. Lefferts offered forty thousand. Edison almost fainted.

With this money Edison



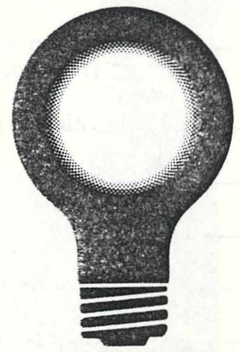
opened his first workshop in *Newark*, New Jersey. He began to manufacture his improvements on the stock ticker. In 1874 he improved the *typewriter*. He substituted metal parts for wooden ones. He also changed the letters and the distribution of ink. Until this time, writing was faster than typing.

In 1876 Edison moved to *Menlo* Park, New Jersey. That same year he added the carbon transmitter to the telephone. People no longer had to shout into the phone.

A year later Edison made a drawing of another invention and gave it to his shop foreman to make. The foreman made what Edison wanted. When he brought the *cylinder* gadget to Edison, he wanted to know what it was. Edison said, "This machine is going to talk." He wrapped a piece of tin foil around the cylinder. Then he recited, "Mary had a little lamb," into the mouth mouthpiece. After one mistake the machine repeated the words. The *phonograph* was born.

Edison's invention of the electric *light* bulb was not original. Many people had experimented with light before. But Edison wanted small lights that could be used in homes or offices. In 1879 Edison worked out a successful principle for the electric bulb. Then he spent two years searching for the proper *filament*, or wire, that would give a good light. One of these experimental filaments was a thin strand of lampblack and tar. He put it into the bulb and drew out the air. Then he turned on the current. The bulb did glow, but it soon went out. After many more tries, he found that carbonized thread worked best in the bulb. For this invention he became known as the "Wizard of Menlo Park."

Edison went on experimenting. He improved the mechanics of motion pictures. Later he combined the phonograph with moving pictures and made talking pictures. He was working on a way to make synthetic rubber when he died at the age of eighty-four. The wizard of Menlo Park had made everybody's life a little brighter.



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A	F	A	G	O	I	I	E	K	E	C
L	E	T	N	N	I	G	N	C	L	T
I	L	O	D	O	T	H	L	I	E	O
F	H	E	Y	O	U	T	O	T	T	R
P	R	E	T	I	R	W	E	P	Y	T

_____ 1. Edison worked with _____ on the train.

_____ 2. The _____ boxed Edison's ears.

_____ 3. Edison's middle name.

_____ 4. Edison invented the _____, which led to the record industry.

_____ 5. "The Wizard of _____ Park" was Edison's nickname.

_____ 6. Edison became almost completely _____.

_____ 7. Edison became an expert on the _____ key.

_____ 8. The stock _____ reported the price of stock to the brokers.

_____ 9. Sight of Edison's first workshop.

_____ 10. Edison spent two years searching for the proper _____ that would give a good light.

_____ 11. Edison wrapped a piece of tin foil around a _____.

_____ 12. Edison invented the electric _____ bulb.

_____ 13. In 1874 Edison improved the _____.

_____ 14. Edison's first telegraph job was in _____.

_____ 15. Marshall _____ became interested in Edison.

Alexander Graham Bell

Alexander *Graham* Bell was born in *Edinburgh, Scotland,* on March 3, 1847. He was taught at home by his mother until he was ten years old. His family was highly educated, and both his father and grandfather were interested in the problems of *speech*. Alexander's father had become one of the first teachers

of speech to the *deaf*.

Young Alexander graduated from the Edinburgh Royal High School and then went to *London* with his grandfather. His grandfather, Alexander Bell, was a noted speech teacher and lecturer. Young Alexander learned much about speech and sound helping his grandfather.

Alexander returned to school to continue his education. When he graduated he taught for a while and then joined his father in his practice in London. His father had originated the phonetic "visible speech" for teaching the deaf. Alexander fit right into his father's practice. He taught deaf children to speak and began to teach others how to teach the deaf.

About this time tragedy struck the Bell family. Alexander's older and younger brothers died from *tuberculosis*. Alexander got the disease too. The family left London because of the damp weather and moved to *Canada*. In the drier air Alexander's health improved.

The next year, in 1873, Alexander moved to the United States. He was appointed professor of Vocal Physiology at *Boston* University. Bell had many deaf students, one of which was *Mabel* Hubbard. Bell taught her, and in the process they fell in love. They did not marry right away because Bell felt he needed more money before he could support a wife.

Bell became interested in the mechanical production of sound. It seemed to Bell that sound wave vibrations could be turned into fluctuating electric current. This current could be carried across wires and then reconverted into sound waves at the other end of the wires. Bell worked with an assistant named *Watson* to make such a machine.

They worked long and hard at the task. One day, as Bell was working with their new machine to carry sound, he spilled battery acid on his pants. Thinking that Watson was in the next room, Bell called out, "Watson, please come here. I want you." Watson was not in the next room. He was on another floor at the other end of the circuit of their new machine. He heard the machine speak and was overjoyed. He ran to tell Bell the good news.

In 1876 Alexander Graham Bell patented the *telephone*. It became an entry at the Centennial Exposition in *Philadelphia* in June, 1876. The judges awarded it a gold medal. This award brought much publicity. Soon telephone lines were being strung. His invention made him enough money so that he could finally, in 1877, marry Mabel Hubbard.

In 1880, after traveling in Europe, Bell returned to the United States, where he began working again. Eventually, he patented a photophone. He applied his telephone idea to transmitting words on a beam of light. It was the first time speech was transmitted without wires.

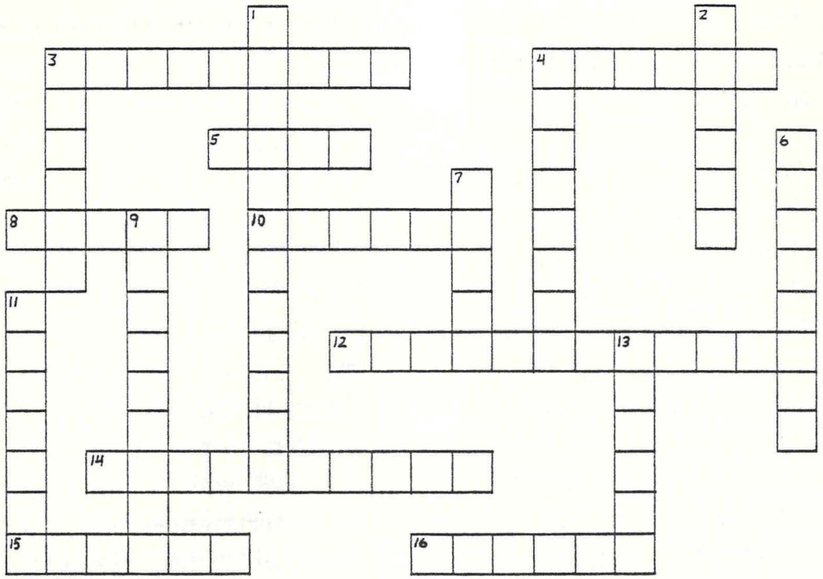
France awarded Bell the *Volta* Prize for the invention of the telephone. Bell used the prize money to establish the Volta Laboratory in Washington, D.C. At the laboratory, Bell and his assistants worked on bettering Thomas *Edison*'s first phonograph. They improved upon it a great deal. Bell later sold his patent on phonograph records for $200,000. He used this money to support the Volta Bureau. The Volta Bureau was formed to work on research connected with deafness.

After President James A. *Garfield* was assassinated, Bell developed a new invention. It consisted of two telephonic devices for finding metallic masses in the human body. This was before the use of X-rays. Doctors were able to use this invention to find hidden bullets or small objects swallowed by children.

Even though successful, Bell still enjoyed inventing things. He took his family to *Nova Scotia* each year so he could "rest." In Nova Scotia he built another laboratory. He worked on hydrofoil speedboats, man-carrying kits, and three-bladed propellers. One of his assistants was Glenn H. *Curtiss*, who later worked on perfecting airplanes.

Bell was extremely busy. He experimented with many practical things. He taught people how to teach the deaf. He wrote in his journal about the experiments he wanted to do. He wrote up those experiments he had done. He was also a founding member of the National Geographic Society.

Alexander Graham Bell died August 2, 1922, at the age of 75. By that time his invention of the telephone had already changed American life tremendously!



ACROSS

3. City in which Bell was born.
4. Bell's middle name.
5. Bell was interested in teaching the _____ children.
8. Bell won the _____ Prize from France.
10. The Bells moved to this country.
12. The Centennial Exposition was held in this city.
14. Bell took his family to _____ _____ each year to relax.
15. The Bells were interested in the problems of _____.
16. Alexander became a professor at _____ University.

DOWN

1. Two of Bell's brothers died from this disease.
2. Bell's famous assistant who heard the first telephone message.
3. _____ invented the phonograph.
4. Last name of President who was shot.
6. Country Bell was born in.
7. Bell married _____ Hubbard.
9. Bell's most famous invention.
11. As a young man, Glenn H. _____ worked as Bell's assistant.
13. Young Alexander helped his grandfather for a time in this city.

Ivan Pavlov

Ivan Pavlov was born in Ryazan, *Russia*, on September 14, 1849. He was the son of a poor parish *priest*. His father was poor, but he had been educated. Ivan was educated too. He attended the local religious school, and his father hoped Ivan would become a priest. Ivan came under the influence of a book, *Reflexes of the Brain*, by I. M. *Sechenov*. His reading helped him realize that he did not want to be a priest. He left the church school and went to the University of St. Petersburg, where he studied natural science.

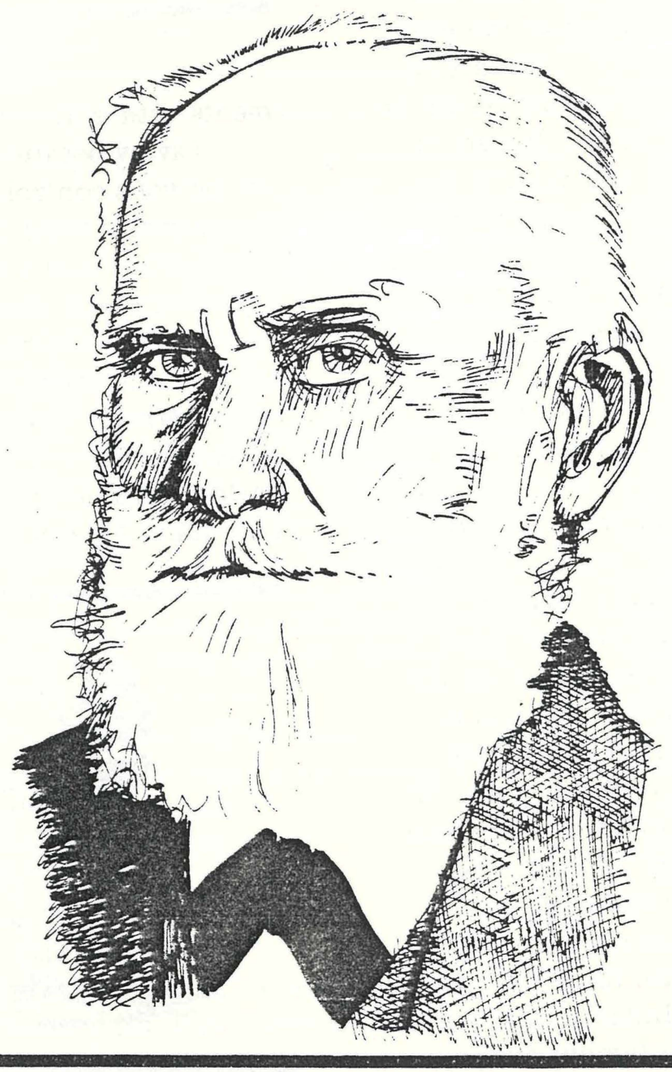
After Pavlov graduated from St. Petersburg, he spent four years at the Military Medical Academy. At the end of four years he had his ***medical*** degree. He had been such an outstanding student that he was awarded a two year study grant. During these two years he traveled to *France* and Germany to study with leading scientists of his day.

When Pavlov returned to Russia, he devoted himself to experimental *research* work. He was asked to organize and direct the department of Physiology in the new Institute of Experimental Medicine. Pavlov held this position for forty-five years! It was at the Institute that Pavlov carried out his famous experiments with *dogs*.

Pavlov became interested in the nervous control of *digestion* and began to form theories about it. He developed a new method of working with dogs that helped his research. He trained animals to lie on the operating table without anesthesia while undergoing his experiments. This way, Pavlov was able to study the functions of the animal without

interference from anesthesia. With the help of the animals, Pavlov proved that all the activities of the body are regulated by the nervous system.

Pavlov became interested in another part of the digestive process after his first experiments were over. He had found that saliva and digestive juices were secreted by the experimental dogs when food was put into their mouths. He also found that he got the same reaction from the dogs when food was sighted, or when footsteps of the person



who fed them were heard by the dogs. The rattling of the dog's dishes brought the same result.

Eventually Pavlov's theories and experiments took shape in a new science. It was the science of higher nervous or *psychic* activity. The basis of this new science was the separating of the reflexes into two types—unconditioned and conditioned reflexes. Pavlov saw experiences as signals from the surrounding world. The higher nervous system has to sort the signals on the basis of reinforcement or lack of reinforcement.

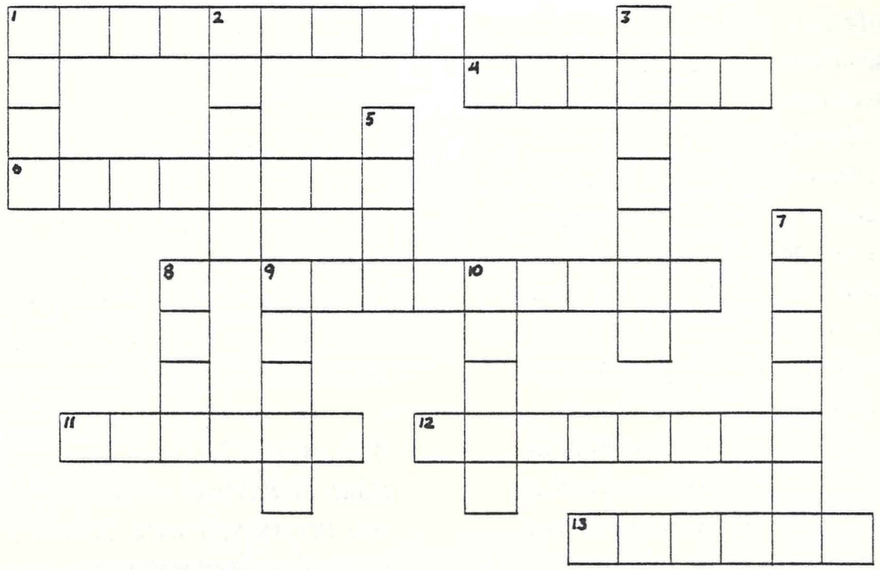
Pavlov's experiments led him to study nervous illnesses in dogs and *apes*, as well as the nature of *sleep*. Pavlov found that sleep penetrated fairly deeply into the lower part of the brain. He found sleep to be protective as well as restorative. As Pavlov experimented, he discovered that he could cause mental illness in dogs and apes. He also found he could cure it. The mental illness in lower animals is caused by too many stimuli overtaxing the nervous system's capabilities. Some of the mental illness could be cured by rest and training. Some could be cured by long periods of sleep. Other forms had to be cured by certain chemicals.

In 1904 Pavlov won the *Nobel* Prize in physiology and medicine. He was the first Russian ever to win the Nobel Prize. This prize led to many other honors for Pavlov. He became a member of the Russian Academy of Sciences as well as a foreign member of the Royal Society in England.

In the Communist Revolution of 1917, *Lenin* became the ruler of Pavlov's country. Lenin was impressed with Pavlov's

work. He gave Pavlov unlimited funds to build, equip, and staff his own laboratories.

Ivan Pavlov died in *Leningrad* on February 27, 1936, but his influence continues. His approach is generally used in certain kinds of mental illness, and there are institutes and clinics that are continuing his work today.



ACROSS

1. Pavlov became interested in the nervous system of _____.
4. Pavlov's father was a _____.
6. Pavlov was influenced by a book by I. M. _____.
9. Pavlov died in this city.
11. Country in which Pavlov was born.
12. Pavlov devoted himself to experimental _____ work.
13. For two years Pavlov studied in _____ and Germany.

DOWN

1. Pavlov did many experiments on _____.
2. _____ penetrates into the lower parts of the brain.
3. Pavlov got a _____ degree.
5. Pavlov's first name.
7. Pavlov's ideas took shape in a new science dealing with _____ activity.
8. Pavlov worked sleep experiments on _____ and dogs.
9. Leader of Russia after the communist revolution.
10. Pavlov won the _____ Prize.

Jan Ernst Matzeliger

Jan Matzeliger was born on September 15, 1852, in *South America.* Jan's father was an *engineer,* and Jan loved to help him. Because Jan was around his father a lot, he became interested in machines. His father thought it was good for Jan to understand mechanical things.

Jan's father decided to move the family to the United States while Jan was still young. Since the Matzeligers were *Negroes* they decided to settle in *Pennsylvania,* which was more willing than some states, to accept Negroes as free people rather than slaves. They settled in *Philadelphia* where Jan began to learn the ways of the United States.

Soon it was time for him to begin to learn a trade. He was good with his hands, so he began to work with a *shoemaker.* At first he did not make *shoes*, he simply helped around the shop. As he became used to the shop and the tools, he was given more responsibility.

Matzeliger learned quite a lot about the slow process of making shoes. When his family moved to *Lynn*, Massachusetts, he continued to make shoes. This time he went to work in a shoe factory. Making shoes in those days was very hard. Everything had to be done by hand. The *cobbler,* or shoemaker, sat at a bench bending over the shoes all day to form each pair carefully by hand.

Matzeliger realized there had to be a better way to make shoes. He began to experiment. He used some of the ideas he had learned as a young boy with his father. He wanted to invent a machine that would make shoes. He had many problems. One of the biggest problems was to find the *time* to spend on his invention. Since he had little money, he had to continue his job at the shoe factory. This left him too tired to do all the things he wanted to do. Another problem was a lack of money. He needed money for his invention, but he didn't have much extra to spend.

Matzeliger worked slowly on his invention. He conquered one problem after another. He ended up making his own tools

and equipment to work on his invention. Finally he thought he had what he wanted. He built a ***model*** of the machine. He built the gears and moving parts carefully by hand. When he was finished, he carefully tried his machine. It worked!

Matzeliger was overjoyed. His machine did most of the slow shaping and folding work with ease and speed. With his machine a cobbler could make two shoes in the time it had taken to form one by hand.

The shoe machine was a benefit to Lynn, Massachusetts. With the new machine, the factories in Lynn could turn out shoes more rapidly than any other factory in the nation. It began to make Lynn a famous town for shoes. Lots of people could now make shoes. No longer did it take a skilled cobbler hours to complete a shoe. This increased ***employment*** in Lynn for less skilled workers.

Also, shoes could be made faster. The people who ran the machines were not paid as much as a skilled cobbler. This meant that shoes could be sold for less.

Even though Jan Matzeliger did not make much money from his machine, he helped the shoe industry and the people in it a great deal. Today his machine is still a major part of the shoe industry.

1. S _ _ _ _ _ _ _ _
2. _ H _ _ _ _ _ _ _ _ _
3. _ O _ _ _ _ _
4. E _ _ _ _ _ _ _ _ _
5. _ _ _ I _ _ _ _
6. _ _ N _
7. _ _ D _ _
8. _ _ U _ _ _ _ _ _ _ _
9. S _ _ _ _
10. T _ _ _
11. _ _ _ R _
12. _ _ _ _ _ Y _ _ _ _ _ _

CLUES

1. Matzeliger began to work for a _____.
2. City in which Matzeliger's parents settled.
3. A shoemaker is also called a _____.
4. Matzeliger's machine increased _____ in Lynn.
5. Matzeliger's father was an _____.
6. City in Massachusetts where Matzeliger worked.
7. Matzeliger built a _____ of his invention.
8. Matzeliger was born in _____ _____.
9. Things Matzeliger's machine made.
10. Matzeliger was short of _____ and money.
11. Race to which Matzeliger belonged.
12. State in which the Matzeligers first settled.

Daniel Hale Williams

Daniel Williams was born in 1858, in *Pennsylvania*. Daniel was a *Negro*, which made things difficult for him in the United States in the years before the *Civil War*. When the Civil War ended in 1865, conditions got better in the United States for Negroes. Still, there were many things they could not do because of white people's prejudice.

As Daniel grew up, he got to go to school. He developed a love of reading. Since he was a good student, he wanted to go further in school. Then Daniel's father died. Daniel's mother decided to move to *Wisconsin* with the five children. Daniel, the sixth child, was left behind to finish his education. This worked until Daniel became lonely for his family. He decided he would leave his schooling and run away from the people who were taking care of him.

Daniel began his adventure with only a few clothes and no money. He had to get from Pennsylvania to Wisconsin. He reached the *train* station and convinced the people that he had no money and that he was trying to find his mother. The train people felt sorry for him and let him travel on the train for free.

Daniel's mother was glad to see him, but angry with him for leaving his schooling. They enrolled Daniel in another school, and he continued his education. In addition to going to school, Daniel began work to help support the rest of the family. He got a fairly good education, but did not make enough money to attend college. At this time Daniel wanted to be a *lawyer*, so he continued to work and began to study law. But in a short time he realized he did not want to be a lawyer. Instead, he thought he wanted to be a *doctor*.

Daniel was lucky. He got the chance to study medicine with Dr. Henry *Palmer*, who was a famed doctor and *surgeon*. Daniel spent two years with Dr. Palmer. He cleaned up the office besides studying the doctor's medical books. Dr. Palmer was able to teach him a lot about medicine as they worked together.

In 1880 Daniel Williams entered *Chicago* Medical College. This was one of the best medical schools in the country. Still, it was not much like medical schools today. It only took eighteen months to become a doctor in those days! The medical college asked Williams to stay on to *teach* after he graduated. After he taught for a time, he left the college to open his own medical *practice*.

Dr. Williams wanted to help other Negroes enter medicine. He began to raise money to help Negroes in Chicago. They were not accepted as beginning doctors in the Chicago hospitals, nor did black women have a school to study medicine.

In 1891 Dr. Williams and the friends who helped him were successful. *Provident* Hospital was opened in Chicago. This was a teaching hospital, too. Provident Hospital trained the first Negro *nurses* in the United States.

Provident Hospital became the scene of an amazing drama in 1893. While Dr. Williams was on duty late one night, a man was brought to the hospital. He had been in a *knife* fight and had been stabbed in the *heart*. The man was bleeding badly, but was not dead. Dr. Williams was willing to do anything to save the man's life. Dr. Williams and six other men decided to try to sew up the man's heart! This had never been done before. There were no X-ray machines to help them. Blood transfusions were not even common at this time to replace lost blood. They could not stop the man's heart to sew it up because they had no way to restart its beating. Dr. Williams achieved the near-impossible! He sewed up a knife wound in a heart that was beating in his hands as he tried to work.

The medical profession was amazed that the man recovered. Others began to dare to do the unusual when trying to save people's lives. Dr. Williams continued to contribute greatly to the medical profession before he died at the age of seventy-three.

1.		_ _ _ M _ _
2.		_ E _ _ _ _ _ _ _ _ _ _
3.		D _ _ _ _ _
4.		_ _ _ I _ _
5.		C _ _ _ _ _ _
6.		_ _ A _ _
7.		L _ _ _ _ _
8.		P _ _ _ _ _ _ _
9.		_ R _ _ _
10.		_ _ O _ _ _ _ _
11.		_ _ _ F _
12.		_ E _ _ _
13.		S _ _ _ _ _ _
14.		_ _ S _ _ _ _ _
15.		_ I _ _ _ _ _ _
16.		_ _ _ _ O
17.		N _ _ _ _ _

CLUES

1. Williams worked with Dr. Henry ____.
2. State in which Williams was born.
3. Williams wanted to be a ____.
4. William's first name.
5. Williams attended ____ Medical College.
6. The college asked Williams to ____ when he graduated.
7. At first Williams wanted to be a ____.
8. Williams set up his own ____ in Chicago.
9. Williams traveled by ____ to his mother.
10. ____ Hospital was started by Williams.
11. Williams sewed up a ____ wound.
12. Williams was the first doctor to sew up someone's ____.
13. Dr. Palmer was a doctor and a ____.
14. The Williams family moved to ____.
15. The ____ ____ occurred in the United States between 1860 and 1865.
16. Race to which Williams belonged.
17. Williams helped Negro women become ____.

George Washington Carver

George Washington Carver was born a *slave* on the Moses Carver *Plantation* near Diamond Grove, *Missouri*. He was born in 1864, just one year from the end of the Civil War. During the last year of the war, thieves raided the plantation. They took the baby and his mother. Moses Carver sent a man to rebuy the mother and her baby. The thieves had already sold the woman but they had found no buyer for the baby boy. The man who had been told to rebuy the stolen slaves traded the master's $300 *race horse* for the baby boy.

Moses Carver's wife had grown fond of the *Negro* boy and his mother before they were stolen. After the boy was returned, she took care of him. When the war ended and the slaves were officially free, he was adopted by the Carvers. They named him George Washington.

George worked around the house with Mrs. Carver. She taught him to cook and sew. When he had free time, he wandered the forest near their plantation. He loved plants and shrubs. Around people he was shy, but he loved flowers.

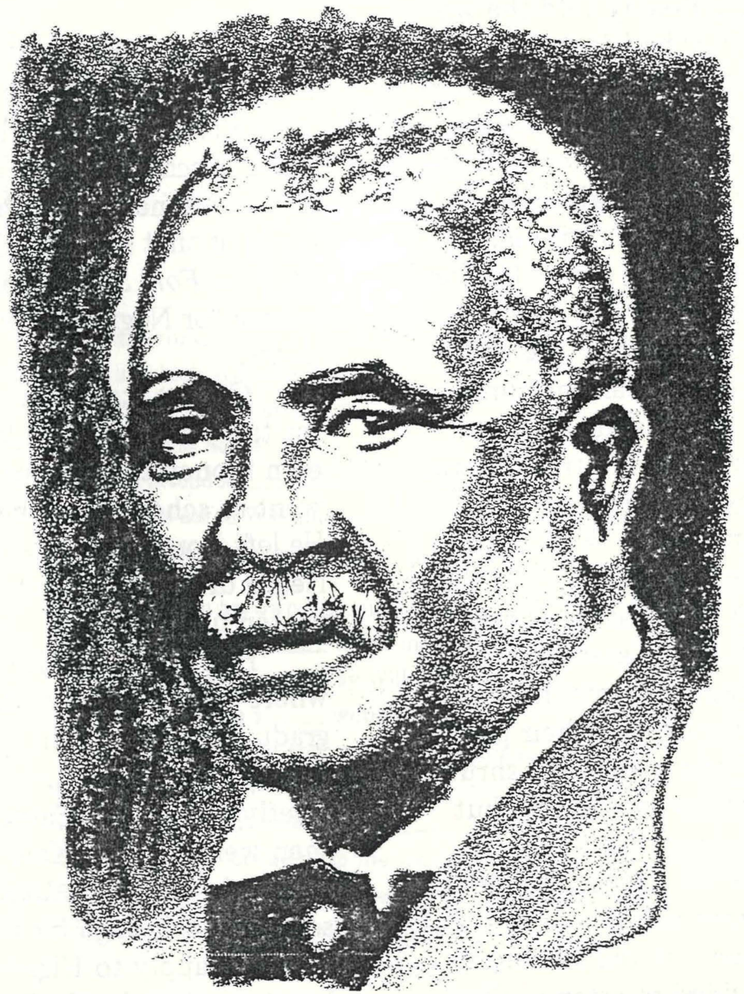
There was a Negro school at *Neosho*, eight miles from the Carver home. At the age of ten, George decided to attend. Since it was too far to travel between home and school, George lived with a Negro family while he went to school. After one year, he had learned as much as he could at that school. He decided to go to *Fort Scott*, Kansas to a school for Negro and white students.

George stayed in Fort Scott for ten years. He had to work to earn money to live, but he also went to school when he could. He left Fort Scott after seeing a Negro dragged out to the jail and beaten until he died.

He continued his education where and when he could, finally graduating from high school at the age of seventeen. He returned briefly to visit the Carvers and then went back to Kansas. In Kansas he opened a *laundry*. He soon made enough money so that he could apply to Highland College to go to school. But when

he arrived to start school they told him he couldn't because he was a Negro! George was shocked. Again he moved, this time westward. But the West could not change his desire for an education.

Then he found a school. He entered *Simpson* College in Iowa. However, again he was broke. A woman told him he could live in her wood shed. Later he started a laundry to make money. George decided he would be of more service to his race in *agriculture* than in art. After four years, he graduated with a bachelor's degree in science.



Carver was offered a job at *Iowa State* College. He was put in charge of the greenhouse. There he could experiment to his heart's content. Soon many people across the nation knew of Carver. By that time he had also received his master's degree.

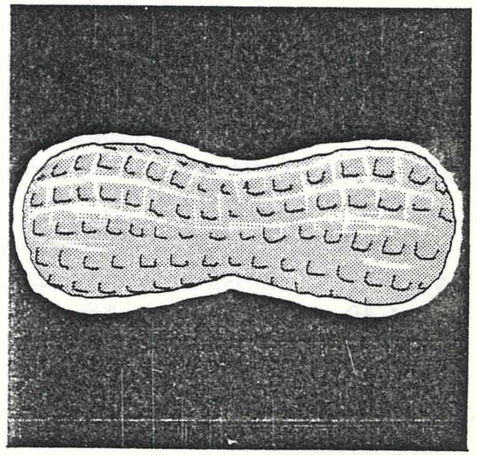
At this time he got a letter from Booker T. *Washington*. Washington, too, had been born a slave. He had opened a university at *Tuskegee*, Alabama. He asked Carver to come teach with them. Carver agreed. Conditions at Tuskegee Institute were poor when Carver arrived. He had to build his own equipment.

Tuskegee was not just a university, but an experimental center for the community as well. *Cotton*, the cash crop of the South, took many minerals out of the soil. Soon the soil could produce little. Minerals had to be put into the soil again. Carver went to work on the soil for the South. From his research, he developed a powder made from clay to clean silver.

Later, he came up with substitute dyes when World War I cut off the supply of dyes from *Germany*. He also used the sweet potato as a bread maker when wheat became short. Carver's greatest fame came from the South's greatest problem. The boll weevil had come into the country and destroyed the cotton crops. The South's economy was dependent on cotton. Carver decided to find something else the South could grow to make money.

He found the *peanut*. The more he worked with the peanut, the more he found he could do with it. In the end he made over three hundred products from the peanut. He made such things as milk, shampoo, wood stains, axle grease, and cereal. The South had a new cash crop, the peanut!

He had become so famous that both Henry Ford and Thomas Edison at separate times asked him to join their staffs, but he refused. He died at Tuskegee in 1943.



1. G _ _ _ _ _ _
2. _ E _ _ _ _
3. _ O _ _ _ _ _ _ _
4. R _ _ _ _ _ _ _ _
5. _ G _ _ _ _ _ _ _ _ _
6. _ _ _ _ E

7. W _ _ _ _ _ _ _ _ _
8. _ A _ _ _ _ _
9. S _ _ _ _ _ _
10. _ _ _ _ H _
11. _ I _ _ _ _ _
12. N _ _ _ _
13. _ _ _ _ _ G _ _
14. _ _ _ T _ _ _ _ _
15. _ O _ _ _ _
16. _ _ _ N _ _ _ _ _

CLUES

1. This country supplied dyes to the United States.
2. Carver found that there were 300 things to be made out of the ____.
3. Carver taught at ____ ____ College.
4. Mr. Carver traded this to get the Negro baby back.
5. Carver studied this to help his race.
6. An unfree Negro of the South.

7. Booker T. ____ asked Carver to teach at his university.
8. Carver made his living while going to school doing this.
9. First college Carver attended.
10. Negro school eight miles from the Carver home.
11. Carver was born in this state.
12. Carver's race.
13. Carver worked at ____ Institute in Alabama.
14. Carver stayed in ____ ____ for ten years.
15. Major crop of the South.
16. Large Southern farms were called this.

Madame Curie

Marie Sklodowska was excited! She had much to be excited about. It was the fall of 1891; she had left her home in *Poland* to come to *Paris*, France. Now she was going back to school. She had registered for the *science* class at the *Sorbonne*. There was nothing she loved better than science.

Marie was a shy girl who enjoyed studying about science. She had worked as a *governess*, teaching other people's children, until she had saved enough money to attend the university in Paris.

There were many young men at the Sorbonne who were interested in Marie. Her ash-blond hair and soft grey eyes were beautiful. But she wasn't interested in men. She had only time for learning.

In order to make her money last longer, Marie rented the cheapest room she could find. Often she was cold and hungry, but she refused to admit that fact even to herself. Her meals were usually buttered bread and tea. When she would allow herself a reward for good work, she would buy an egg or a piece of chocolate.

In 1894, she met an unusual man at the Sorbonne. He was *Pierre Curie*. Never before had Pierre met a woman he could talk science with. At thirty-five he was still unmarried, but he decided he had to marry Marie. She was not too interested, however. Her main love was still science. But, after being with Pierre and working with him for ten months, she finally agreed to marriage.

Her marriage to Pierre was wonderful. They could talk together of the science that they both loved. In their second year of marriage, Marie gave birth to a daughter, *Irène*. Still this did not slow down Marie's scientific pursuits.

She and Pierre became interested in an article written by Henri *Becquerel*. This article spoke of the rays given off by *uranium* without exposure to light. Both became interested in what caused the rays.

They set up a small, ground floor storeroom as a laboratory. There they worked to find what had caused the mysterious rays. They discovered that other material gave off the strange rays, too. Marie named these strange rays, *radioactivity*. Marie examined all the known *elements*. They did not give off radioactivity. They had to be on the trail of a new element!

Pierre and Marie worked together. In December, 1898, they announced a new element, which they called *radium*. Now came the hardest part. They had to prove the existence of this new element and measure its atomic weight. Together, they worked on this for four years. At the end of that time, they had enough radium to measure its atomic weight.

During these four years money was always a problem. They both taught. While they were fighting poverty, they also discovered that radium could be used to fight disease. It was useful! And they were the only ones who knew how to process radium. They could have become wealthy with their discovery. But Marie said, "It would be against the scientific spirit." To anyone who asked, they explained the process that would result in radium.

In 1903 Sweden announced that Pierre and Marie would receive the Nobel Prize in *Physics*, along with Henri Becquerel. This meant $15,000 to the Curies. No longer would money be the problem that it once had been. In December, 1904, Marie gave birth to their second daughter, *Eve*. She would eventually write the story of her parents' discovery of radium.

Many honors came to the Curies. They were able to build the laboratory they both had wanted so much. However, just when things were going so well, tragedy struck. Pierre was absentmindedly crossing the street on a rainy day when he was hit by a horse-drawn wagon and killed. Now Marie was alone again. Only the work they had both loved saved her. She continued to teach, work in the laboratory, and be with her two little girls.

Madame Curie's fame continued to spread. She was given the Nobel Prize in *Chemistry* in 1911. It was almost unheard of that she should receive such an honor twice.

She received many other offers and awards in her life. And she traveled many places helping people understand and use radium. In 1921, the women of the United States asked Marie Curie to come to *America* to receive a *gram* of radium. This gram was worth $100,000. She did come to America, but was bothered by the noise and confusion. Soon she returned to France and to her laboratory.

Marie had always taught her students how to handle the dangerous radium, but she hadn't followed her own advice. For thirty-five years she had worked with radium and breathed the substance given off by it. Her blood content was no longer like that of healthy people. In May, 1934, she was forced to bed, feverish. Her body could no longer fight the affects of radiation. Madame Curie died July 6, 1934.

Y	T	I	V	I	T	C	A	O	I	D	A	R	
R	G	L	E	R	E	U	Q	C	E	B	P	A	
T	O	Q	N	A	C	I	R	E	M	A	O	D	
S	V	U	E	I	R	U	C	P	R	V	L	I	
I	E	R	R	E	C	N	E	I	C	S	A	U	
M	R	A	I	B	O	N	S	E	V	E	N	M	
E	N	N	O	B	R	O	S	R	A	M	D	S	
H	E	I	L	L	O	E	I	R	A	M	A	D	
C	S	U	Q	E	L	E	M	E	N	T	S	O	
A	S	M	A	R	G	S	C	I	S	Y	H	P	

_____ 1. ____ wrote about her famous parents.

_____ 2. Marie Curie came from this country.

_____ 3. ____ Curie married Marie.

_____ 4. Marie studied this subject.

_____ 5. Occupation Marie had while earning money for school.

_____ 6. City in which the Curies worked.

_____ 7. Madame Curie's first name.

_____ 8. Henri ____ shared their first Nobel Prize.

_____ 9. The first Nobel Prize was in ____.

_____ 10. Madame Curie came to ____ to be honored.

_____ 11. Name of the new element discovered.

_____ 12. Marie Curie named the strange new rays, ____.

_____ 13. Marie Curie examined all the known ____.

_____ 14. Becquerel wrote an article about ____.

_____ 15. First daughter.

_____ 16. Marie studied at the ____.

_____ 17. Curie won the Nobel Prize in ____ in 1911.

_____ 18. Curie received a ____ of radium in the United States.

_____ 19. Last name of famous husband and wife scientists.

Lise Meitner

Lise Meitner was born in *Vienna,* Austria on November 7, 1878. Her father was a lawyer. He thought that learning was important, so Lise was given a good education. One of the areas she was interested in was science. She studied at the University of Vienna, where Boltzmann was one of her teachers. In 1902 she became even more interested in science. It was in that year that Pierre and Marie *Curie* announced their discovery of radium. Lise continued her education and graduated in 1906 with her doctorate.

In 1907 Lise Meitner traveled to Germany. She went to *Berlin* for one special reason. *Max* Planck was giving a series of lectures there, and Lise wanted to hear them. Planck was a well-known German physicist. He would go on with his research and win the Nobel Prize in physics in 1918.

While Meitner was in Berlin she met many brilliant men. One of these was *Otto Hahn*, a German chemist and physicist. He expecially impressed her. Dr. Hahn was different from most men. He realized that Lise Meitner was more than just a woman—she was a first-rate physicist. While others made fun of Meitner because she was a woman scientist, he did not.

After Planck's series of lectures were over, Meitner stayed in Berlin. She teamed up with Otto Hahn to do research. This teamwork lasted thirty years.

O. HAHN

During this time she continually had to fight to be accepted as a scientist. The German professors did not believe that women were able to do the thinking needed to be a physicist.

Emil Fischer was one of these men. Fischer had won the 1902 Nobel Prize in Chemistry. Meitner wanted to work with Fischer. He was a brilliant man in his field, and she could learn much from him. Fischer finally allowed her to work with him. She had to promise, however, never to go into the laboratories where men were working!

When World War I occurred, She became a *nurse* in the Austrian army. When the war was over, she returned to her research.

In 1933 Adolf *Hitler* came to power in Germany. One of the first things Hitler did was to begin the separation of the *Jews* from the rest of the German people. Once the separation was done, the discrimination began. Meitner was Jewish, but at first she was protected because she carried an Austrian *passport*. Hitler did not want trouble with Austria, so Lise was temporarily safe.

The safety of Meitner's passport came to an end in 1938. At that time Germany took over Austria. She was forced to leave Germany to avoid being taken by the Nazi soldiers. She had seen that she would probably have to leave Germany one day, so she had written to her scientist friends in the *Netherlands*. They had agreed to a plan. Meitner followed this plan and was able to enter the Netherlands without a visa.

She traveled to Stockholm where she met Niels *Bohr*. Niels Bohr was a physicist who had won the Nobel Prize in Physics in 1922 for figuring out the structure of the atom. He was against Hitler and was willing to help her. Bohr helped her obtain a position with Karl *Siegbahn*. Siegbahn was a Swedish physicist who had also won the Nobel Prize in Physics.

Meitner worked in Stockholm and became convinced of the actuality of uranium fission. In January, 1939, she published the first report about it. Otto Hahn managed to split the uranium atom that same year.

Meitner survived World War II and traveled to the United States after it was over. She returned to *Sweden*, however, and became a citizen of that country. She moved to *Cambridge*, England, in 1958, to continue her work. In 1966 she was granted a share of the *Fermi* Award. She was given this by the U.S. Atomic Energy Commission for her work. She was the first woman to win the award.

Lise Meitner lived three months after the death of her friend and co-worker, Otto Hahn. She died in Cambridge, England, on October 27, 1968.

Lise Meitner gave up her scientific world. She wanted to help her country any way she could.

T	E	G	D	I	R	B	M	A	C	X
R	V	H	X	H	B	E	S	R	U	N
O	N	A	A	I	O	T	T	O	R	A
P	E	H	M	T	H	W	E	J	I	N
S	D	N	A	L	R	E	H	T	E	N
S	E	S	I	E	G	B	A	H	N	E
A	W	B	E	R	L	I	N	B	E	I
P	S	W	E	L	I	M	R	E	F	V

_____ 1. First name of Dr. Hahn.

_____ 2. City in which Meitner was born.

_____ 3. City in which Meitner died.

_____ 4. Meitner became a citizen of this country.

_____ 5. Meitner escaped Germany to the _____.

_____ 6. Last name of pair who discovered radium.

_____ 7. Meitner went to _____ to hear Planck speak.

_____ 8. During World War I Meitner was a _____.

_____ 9. Adolf _____ came to power in 1933.

_____ 10. For a time Meitner's Austrian _____ kept her safe.

_____ 11. Meitner won part of the _____ Award.

_____ 12. First name of Planck.

_____ 13. Meitner got a position with Karl _____.

_____ 14. Niels _____ helped Meitner.

_____ 15. Meitner was a _____, which caused her trouble in Hitler's Germany.

_____ 16. Last name of man with whom Meitner did research for thirty years.

Anna Freud

Anna Freud was born in *Vienna, Austria,* on December 3, 1895. She was one of six children born to *Sigmund* Freud and his wife. Her father became a famous man who founded psychoanalysis. He had many new ideas, especially about human behavior and the treatment of behavioral disorders.

Anna was greatly influenced by her famous father. She wanted to help him with his work. When her father was criticized by other doctors of the time, she wanted to defend him and prove to the world that his theories were correct.

In order to truly help her father, Anna tried to do well in school. She went to many schools and became one of the most educated women of her time.

When Anna was nineteen, *World War I* broke out in Europe. The Freud family stayed in Austria, but conditions for them were very difficult. Often there was not enough food or fuel to keep warm. The end of the war brought a new kind of struggle. The Austrian money system collapsed. This meant that all of Anna's and her father's *savings* were wiped out. Oftentimes they did not know how they would get enough money to eat that day.

When times improved Anna continued her psychoanalytic training. She also began to help her father a great deal. In 1923 it was discovered that her father had *cancer* of the upper part of the mouth. For sixteen years he

underwent operations and struggled to defeat the disease. Anna spent much of this period helping him as well as working on her own.

Anna Freud began to make important contributions to psychoanalytic theory. She worked with the theory called "*ego* psychology." She wanted to find how the ego functions in the development of the personality. After considerable work she published a book, ***Ego and the Mechanisms of Defense***. In it she pointed out how the ego defends itself from unpleasant or harmful situations. She also explained how this defense by the ego can affect the development of an individual's *personality*.

World affairs began to interfere again. Adolf *Hitler* had taken control in *Germany*. He began a campaign against other nations in Europe and against the *Jewish* people. Since the Freuds were Jewish, Hitler ordered their works burned. In 1938, Germany invaded Austria, and Anna and her father fled to *England*.

Anna Freud and her father were welcomed in England. Again he was operated on for cancer. Anna helped her father as much as she could and began

her own life in England. She became the director of the *Hampstead* Child-Therapy Clinic.

Her life was upset with the death of her father in 1939, but she had found satisfaction working in England. The Second World War again disrupted her life, but she continued to work with the young, developing new ways to treat distressed *children*. After the war she published her findings in another book, ***Psychoanalytic Treatment of Children***.

Anna Freud continues to make great strides in the world of psychoanalytic theory. She has begun with some of her father's ideas and developed them further to help the children of today.

1.							P	_	_	_	_	_	
2.							S	_	_	_	_	_	_
3.	_	_	_	_	_	_	_	_	_	_	_	Y	
4.							C	_	_	_	_	_	
5.							H	_	_	_	_	_	
6.						_	_	O					
7.							A	_	_	_	_	_	_
8.						_	N	_	_	_	_	_	
9.	_	_	_	_	_		_	A	_		_		
10.					_	_	_	L	_	_	_	_	
11.				_	_	_	_	_	_	Y			
12.							S	_	_	_	_	_	_
13.						_	I	_	_	_	_		
14.					_	_	_	_	S	_			

CLUES

1. Anna Freud worked at the ____ Child-Therapy Clinic.
2. ____ Freud was Anna's father.
3. Anna Freud was interested in the development of a person's ____.
4. Disease that killed her father.
5. Leader of Germany.
6. Anna Freud worked with ____ psychology.
7. Country in which Anna Freud was born.
8. Country that welcomed Anna and her father.
9. When ____ ____ ____ broke out, Anna Freud was nineteen.
10. Anna Freud has been working with ____.
11. ____ invaded Austria.
12. During World War I their ____ were wiped out.
13. City in which Anna Freud was born.
14. Religion to which Anna Freud and her father belonged.

Irène Joliot-Curie

Irène was born in *Paris, France,* on September 12, 1897. She was the daughter of *Pierre* and *Marie* Curie. Her parents worshipped one another. Also, they were both scientists. They worked together in their laboratory many hours a day. Often, it seemed, there was little time in their busy lives for Irène and her sister, *Eve*. Still, the girls knew they were loved and that their parents were doing important work in physics and *chemistry*.

Irène was nine years old when her world was shattered. Her quiet, loving father was killed as he walked across the busy street in front of their laboratory in Paris. Irène knew her life would never be the same. She also knew her mother would miss her father more than Irène did.

Irène continued with her school work. She was educated privately rather than going to public schools. When she was old enough, she attended the *Radium* Institute of the University of Paris. Irène had grown up with science. She had always been involved with one form of science or another, it seemed. It was natural that Irène should help her mother after Irène's father died. Eventually she became her mother's *assistant*.

Marie and Pierre Curie had discovered polonium and radium. Marie had continued her work with radium and finally isolated it. Irène was happy to be her mother's assistant. While Irène was working with her mother, she met and worked with Frédéric Joliot, another assistant helping her mother.

Irène could remember how happy her mother and father had been working together. When Frédéric Joliot proposed to Irène, she hoped they would be as happy and do as much for science as her parents. Irène and Frédéric were married in 1926.

Irène took over the research on radium when Marie Curie had to retire because of ill health. Irène became chief of works at the Radium Institute in 1932. She and Frédéric continued their work in chemistry. In 1935 this paid off. She and Frédéric won the *Nobel Prize* in Chemistry.

Irène Joliot-Curie continued to work hard. In 1936 she was appointed under secretary of state for scientific research in the cabinet of Leon *Blum*. After World War II she became active in politics too. She had hated the war years and hoped to keep some of these things from happening again.

Joliot-Curie helped organize the French *atomic energy* commission and served this group until 1951. In 1951 she was removed from the commission because of her *communist* beliefs.

Joliot-Curie's political beliefs did not prevent her from being an excellent scientist. She taught at the *Sorbonne* and became the director of the radium laboratory there. Unfortunately, Irène Joliot-Curie's life was short. She contracted *leukemia*, as her mother had done. This disease was brought on by years of working with radioactivity and radioactive metals. She died in Paris on March 17, 1956.

1. _ _ _ I _ _ _ _ _
2. _ _ R _ _
3. _ _ E _ _ _ _ _
4. _ _ _ N _ _
5. _ _ E _ _ _ _ _ _

6. J _ _ _ _ _
7. _ O _ _ _ _ _ _
8. _ L _ _
9. _ _ _ I _ _
10. _ O _ _ _ _ _ _ _ _ _
11. _ T _ _ _ _ _ _ _ _ _ _ _

12. C _ _ _ _ _ _ _ _
13. _ _ U _ _ _ _ _
14. _ _ _ R _ _
15. _ _ _ I _
16. E _ _

CLUES

1. Irène was her mother's ____.
2. City in which Irène was born.
3. First name of the man Irène Curie married.
4. Country in which Irène was born.
5. Irène Joliot-Curie won the Nobel Prize in ____.

6. Last name of man Irène Curie married.
7. Joliot-Curie became a teacher here.
8. Joliot-Curie served in Leon ____'s cabinet.
9. Joliot-Curie worked with this.
10. Famous award given to Irène and Frédéric.
11. Joliot-Curie helped organize the French ____ ____ commission.

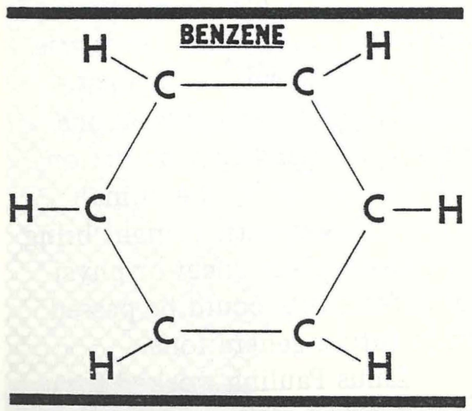
12. Political belief held by Irène Joliot-Curie.
13. Disease that killed Joliot-Curie.
14. Name of Irène's father.
15. Name of Irène's mother.
16. Name of Irène's sister.

Linus Carl Pauling

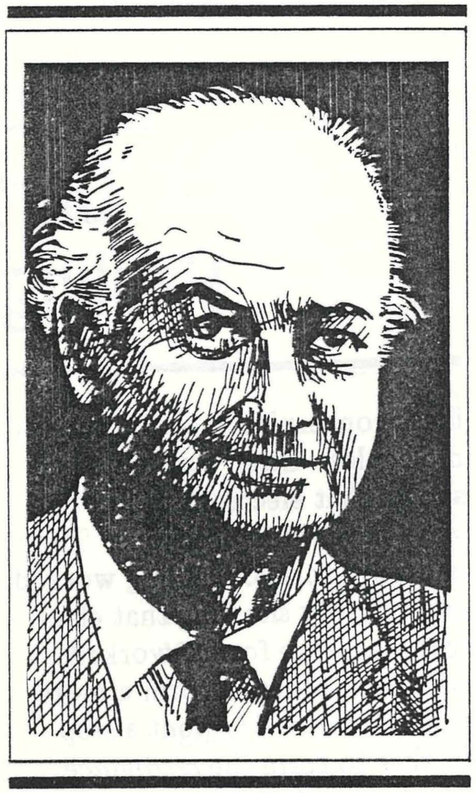
Linus Pauling was born in *Portland, Oregon,* on February 28, 1901. He was the son of a druggist. One of Linus's friends had a chemistry laboratory in his home. Together the boys worked and mixed chemicals. This early hobby grew to be Linus's main interest.

Linus attended Oregon State College, even though he had not earned a high school diploma. He had not taken the proper courses to graduate from high school, but Oregon State accepted him anyway. He graduated in 1922, then continued with his schooling, receiving his Ph.D. in 1925 from the California Institute of Technology.

Pauling began investigating the structure of *molecules.* He experimented with the chemical *bond* that held molecules together. By 1926, he had published a paper on the structure of *benzene*. He had arrived at new ideas concerning the structure of molecules. Other scientists had shown that electrons did not always have fixed positions. They had wave forms. Pauling worked out a theory showing that electrons, as wave forms, worked with each other to form a more stable system. He went a step further to form the *resonance* theory.



Pauling used the resonance theory to explain the structure of certain molecules. It helped explain why no regular chemical bond held certain molecules together. This theory accounted for the chemical structure of dyes and also led to the development of new drugs and plastics. Pauling wrote a book, *Nature of the Chemical Bond and the Structure of Molecules and Crystals.* It became a classic in the field of chemistry and brought him fame and prizes from the scientific community.



Next Pauling turned his attention to the molecular structure of *proteins*. Studying the structure of molecules of living tissue was much more complex than Pauling's other work. He used X-ray *diffraction* in his work. When light is sent through a crystal, it diffracts or spreads out into bands of colored lights. The makeup of the crystal can then be studied easier.

After fourteen years of work, Pauling and Robert B. *Corey*, who had been working with him, announced that they had discovered the structure of several types of protein molecules. This was the first time that anyone had figured out the structure of any protein molecule. They found that protein molecules are arranged in the form of a ***helix***. A helix looks like a spiral staircase.

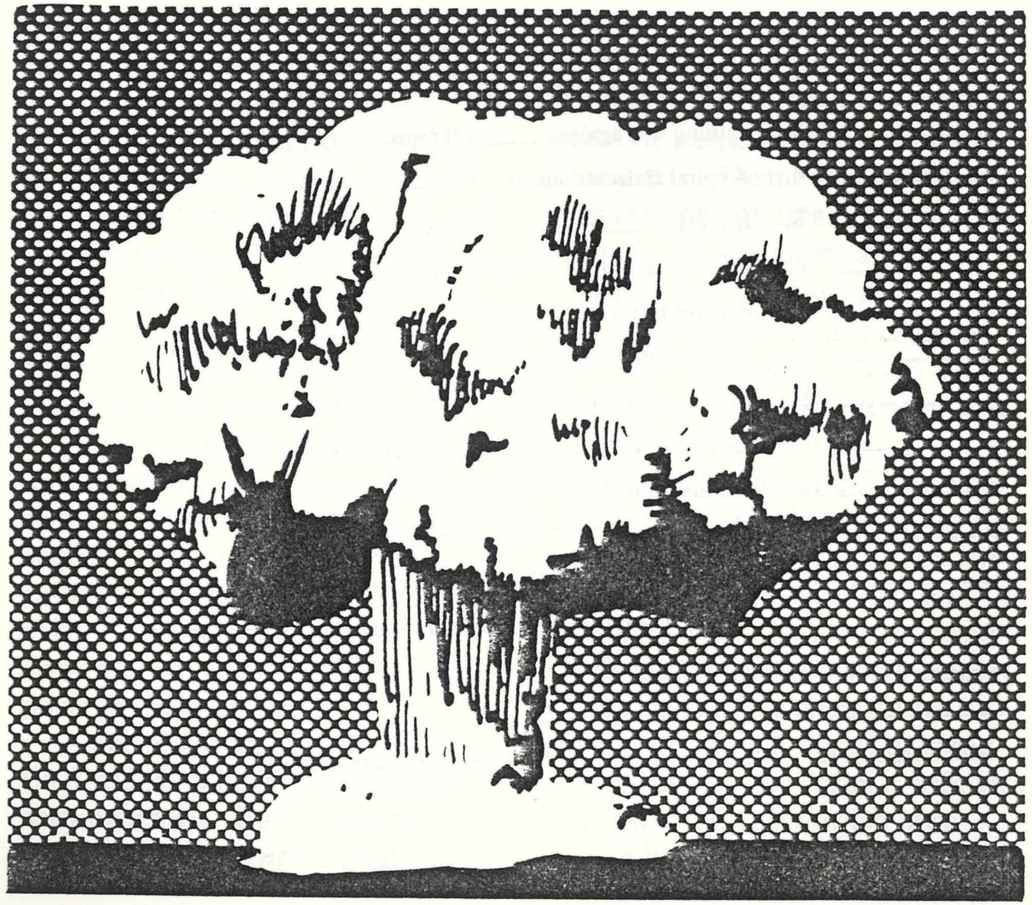
Understanding the structure of the molecule of protein led the way toward the control of various diseases. Pauling studied certain blood diseases. He worked out theories on the structures of abnormal hemoglobin. This introduced the idea of molecular disease. This would be a disease caused by the abnormal structure of a protein molecule.

In 1954 Linus Pauling received a great honor. He was awarded the *Nobel* Prize in *Chemistry* for his work on molecular structure.

Pauling became concerned with the destruction potential of *nuclear* weapons. He felt it was his duty to speak out against the testing of nuclear weapons. He saw the dangers of radiation being absorbed by the human body. This radiation might bring on diseases like cancer or physical defects that could be passed on to future generations.

Linus Pauling worked for a nuclear test ban treaty. He was not always understood by Americans. Many felt he was against what would be good for his country. In 1962, however, Linus Pauling was recognized for the work he was doing. He won the Nobel *Peace* Prize. He was the first person to receive two complete Nobel Prizes (Madame Curie had won one prize and shared in another).

In 1970 Pauling again made headlines. He stated that large doses of *vitamin* C would prevent the common *cold*. The medical world became divided. Some said he might be correct, others said he was mistaken. Much of his work to earn the Nobel Prizes has now been forgotten. He is recognized more often for his questionable stand on the value of vitamin C. This has done much to weaken the reputation of an outstanding chemist and humanitarian.



Y	E	R	E	S	O	N	A	N	C	E
R	O	D	N	A	L	T	R	O	P	L
T	N	X	I	L	E	H	A	G	E	U
P	I	D	N	O	B	F	E	E	A	C
R	M	C	D	L	O	C	L	R	C	E
O	A	O	O	B	N	F	C	O	E	L
T	T	R	D	L	I	N	U	S	Z	O
E	I	E	E	N	E	Z	N	E	B	M
I	V	Y	R	T	S	I	M	E	H	C
N	O	I	T	C	A	R	F	F	I	D

_____ 1. City in which Pauling was born.

_____ 2. Pauling felt he knew a cure for the common ____.

_____ 3. Pauling was against ____ weapons.

_____ 4. A spiral staircase shape is a ____.

_____ 5. Robert B. ____ helped Pauling.

_____ 6. Pauling developed the theory of ____.

_____ 7. Pauling won two ____ prizes.

_____ 8. State in which Pauling was born.

_____ 9. Pauling won the Nobel ____ Prize in 1962.

_____ 10. Pauling worked on the molecular structure of ____.

_____ 11. Pauling used X-ray ____ in his work.

_____ 12. Pauling felt ____ C could help against colds.

_____ 13. In 1926 Pauling published a paper on the structure of ____.

_____ 14. Pauling was interested in the structure of a ____ of protein.

_____ 15. In 1954 Pauling won the Nobel Prize in ____.

_____ 16. First name of Pauling.

_____ 17. A chemical ____ holds some molecules together.

Enrico Fermi

Enrico Fermi was born in *Rome, Italy*, on September 29, 1901. He grew up in Italy during the First World War. He graduated from the University of *Pisa* in 1922, just a few months before Benito *Mussolini* took power in Italy. Fermi had graduated at the top of his class, and he went on to study in *Germany*. When he returned, he became a professor of *physics* at the University of Rome.

Fermi became interested in the behavior of electrons in solids. He worked with these until the discovery of the *neutron*. With the neutron, many new types of nuclear reactions could be started. The neutron was not repelled by the atomic nucleus, as other particles were. Because the neutron was not pushed away, it was not necessary to build up neutron energies before it would be accepted.

The more Fermi worked with neutrons, the more things he found out. Neutrons started nuclear reactions easier if they passed through water or wax first. Fermi found that they slowed down after passing through these media.

Fermi got an idea in 1934. He decided to bombard *uranium* with neutrons. He wanted to form a new *element*. Fermi thought he had succeeded, but wished to test it some more. One of his superiors gave the news to the papers, however. Mussolini had become a dictator of Italy, and he wanted to impress the world with the greatness of Italian science. For the most part, Fermi was wrong in his attempt to create a new element. He was angry about the publication of his ideas too soon. Nevertheless, Fermi was given the *Nobel* Prize in Physics in 1938 for his work with neutron bombardment.

More and more Fermi had gotton into trouble in Italy. He was against Mussolini's dictatorship. At the Nobel Prize ceremony he did not wear the army uniform or give the army salute. This caused Mussolini to be angry at Fermi. Another thing caused trouble. Fermi's wife was *Jewish*, and anti-Jewish laws were being passed in Italy.

Fermi escaped from Italy with his family, thanks to a friend. Fermi had been told earlier that he was probably going to get the Nobel Prize. This had given Fermi time to get things ready. When he and his wife went to Stockholm to receive the Prize, he knew he would not return to Italy. They left Stockholm and went to the *United States.*

Fermi continued to work with neutrons in the United States. He and the people working with him began to wonder if they could set up a nuclear *chain reaction,* all from one neutron. When it was decided to try to build a structure in which a nuclear chain reaction could take place, Fermi was placed in charge of the building.

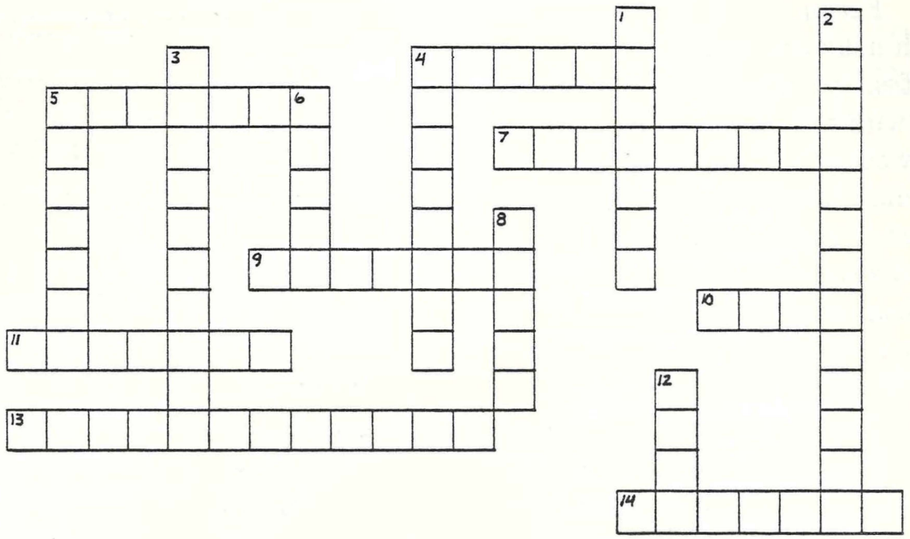
The term *atomic pile* was used to describe the material Fermi and others were working with. It was used because others would not know what kind of work they were doing. The atomic pile was really the first nuclear reactor.

The chain reaction worked on December 2, 1942, and the atomic age was born. Since the United States was in World War II at this time, the chain-reaction was kept secret from most. A telegram with the news was sent to those who had a right to know. The telegram said: "The Italian navigator has entered a new world." Fermi had entered a new world; the world of atomic energy.

It would be less than three years later that the power of atomic energy would be shown to all people. Two atomic bombs were dropped on two *Japanese* cities. It led to the end of the

Second World War. But it also brought tremendous loss of life. The world had its first experience of the atomic age.

Enrico Fermi became a citizen of the United States in 1945. He was made a professor at the Institute of *Nuclear* Studies. He died in 1954 after having been one of the first atomic physicists in the world. Unfortunately, he did not live to see the attempts at peaceful uses of atomic energy. Even though it had helped end World War II, Fermi felt that he had turned a terrible force upon the world.



ACROSS

4. Mrs. Fermi belonged to this religion.
5. Fermi worked with electrons until the ____ was discovered.
7. Benito ____ became a dictator.
9. Fermi wanted to make a new ____.
10. Fermi went to the University of ____.
11. Fermi wanted to bombard ____ with neutrons.
13. Fermi became a citizen of the ____ ____ in 1945.
14. Fermi studied in this country.

DOWN

1. Fermi became a professor of ____.
2. Fermi set up a ____ ____ from one neutron.
3. The first nuclear reactor was called an ____ ____.
4. The first atomic bombs were dropped on two ____ cities.
5. Fermi became a professor of ____ studies.
6. The ____ Prize for physics was given to Fermi.
8. Country in which Fermi was born.
12. City in which Fermi was born.

Margaret Mead

Margaret Mead was born in Philadelphia, *Pennsylvania,* on December 16, 1901. Both of Margaret's parents had college degrees, and as Margaret grew up she knew she would go to college too. Her mother was a *sociologist,* and she taught Margaret how to take notes on the behavior of people. This was a skill she would use later in her life.

Margaret attended school and finally got to college. She was interested in a career in English until she took an anthropology class from Professor Franz *Boas.* This influenced her so much that Margaret decided to make a career of anthropology. By 1929 Margaret had earned her Doctoral Degree from *Columbia* University.

Dr. Mead received a National Research Council Fellowship and was appointed an associate at the Bishop Museum in *Honolulu.* Her first study was on the island of *Tau* in the *Samoan* Islands. She wanted to study how adolescent girls develop in primitive cultures. Mead spent a long time on Tau studying the native people. Her mother's teachings on observing behavior helped her a great deal. When she returned to civilization, she was appointed assistant curator of ethnology at the American Museum of Natural History.

To Margaret Mead, the *field studies* were always the most interesting aspect of her work. Before she began her next study, however, she worked up her ideas and findings about Samoa. She wrote a book, *Coming of Age in Samoa,* about her first field study. Many people became fascinated with what Mead had found in Samoa. The book sold well, and many people soon knew of the work she was doing.

Mead's second field study was of the *Manus* tribe of the Admiralty Islands. She had help with this study. Dr. Mead had met and married Dr. Reo *Fortune,* an anthropologist from New Zealand. After their study, Margaret wrote *Growing Up in New Guinea,* which was not as popular as her first book.

Soon Dr. Mead was off on another field study. This time she visited an American *Indian* tribe. Again, when she was through, Dr. Mead wrote a book. It was called *The Changing Culture of An American Indian Tribe.*

Probably Dr. Mead's most misunderstood book came from a study of three tribes. It was called *Sex and Temperament in Three Primitive Societies.* She had studied how each tribe trained and conditioned the females and males of their tribe.

When the book was published, many thought it was an excellent study and that it was interesting to read, too. Others thought it was a worthless study that had no bearing on American ways of life.

Dr. Mead and Dr. Fortune had obtained a divorce, and in 1936 she married Gregory *Bateson,* an English anthropologist. Together they continued their field studies in Bali and New Guinea.

Margaret Mead became one of the best known anthropologists in the world. Many people did not agree with her theories concerning adolescent and child care and sexual behavior. She studied primitive tribes and compared them with the American culture. She showed that primitive adolescents were under less stress and strain than American adolescents. They also knew what was expected of them in their tribe, which gave them a sense of security.

The studies of primitive tribes done by Dr. Mead are invaluable. The world is no longer the same as it was, and Dr. Mead's studies have preserved the past of these cultures for the world to study and understand. Margaret Mead died of cancer on November 15, 1978.

1. _ A _ _ _ _
2. _ N _ _ _ _
3. T _ _
4. H _ _ _ _ _ _ _
5. _ R _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
6. _ O _ _
7. P _ _ _ _ _ _ _ _ _ _ _ _ _
8. _ O _ _ _ _ _ _
9. _ _ _ _ _ L _ _ _ _ _
10. _ O _ _ _ _ _
11. _ _ _ _ _ G _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
12. _ I _
13. _ _ _ _ S
14. _ _ T _ _ _ _

CLUES

1. Mead first studied the people of the ____ Islands.
2. *The Changing Culture of the American* ____ *Tribe.*
3. Samoan island studied by Margaret Mead.
4. Bishop Museum is located here.
5. Mead studied three ____ ____.
6. Professor Franz ____ influenced Margaret Mead.
7. State in which Margaret Mead was born.
8. Mead got her Doctorate at ____ University.
9. Mead's mother was a ____.
10. Mead married Dr. ____.
11. Mead's first book was called this.
12. Mead thought ____ ____ were the most interesting.
13. Mead studied the ____ tribe of the Admiralty Islands.
14. Mead married Gregory ____.

Louis Leakey

When people ask, "Where did humans come from?" they should turn to the work of Louis Leakey. He was an anthropologist, archaeologist, and paleontologist. He became convinced that humans first evolved in *Africa*, not *Asia*. Then he spent his life trying to prove his theory. He was joined by his wife, *Mary*, and their sons.

Louis Leakey was born at Kabete, *Kenya*, on August 7, 1903. His parents were missionaries who had been sent to this area to Christianize the *Kikuyu* Tribe. Louis learned the African dialects before he learned English. As he grew up, he became interested in birds. It was this interest that led him to accidentally discover stone tools and weapons in ravines and gullies. Louis was loved by the Kikuyu people. He was initiated into their tribe at thirteen and named Son of the Sparrow Hawk. He was taught to stalk wild game. He was also taught the ancient stories of the tribe.

Louis was educated by his parents until he was sixteen. Then he had to leave Africa and go to *England* for his education. He went to public school for two years to prepare for college. During Leakey's second year at *Cambridge*, in 1924, he was hurt playing *rugby*. His head injury seemed to get better, but he was left with terrible headaches. His doctors told him to take a leave of absence. He joined an archaeological expedition formed by the British Museum. They went to Tanganyika (now Tanzania). W. E. *Cutler*, a Canadian paleontologist, led the group. He taught Louis many valuable skills and techniques.

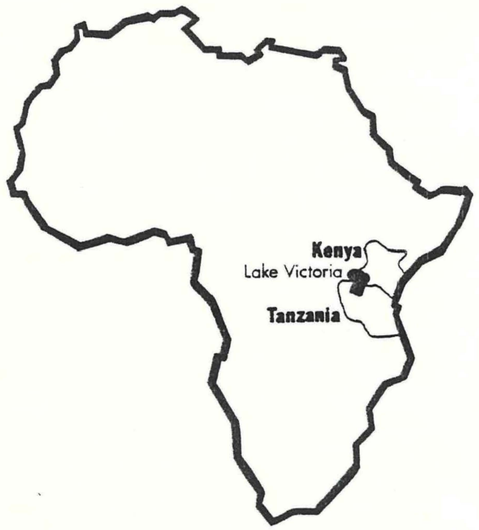
Leakey became fascinated with the hunt for early humans. He led four fossil-hunting trips to East Africa over the next ten years. His Cambridge professors suggested that he look in Asia instead of Africa. Everybody knew that the human race started there. But Leakey insisted on searching in Africa. In 1929 he was rewarded. He was in Kenya when he almost fell over a hidden *cliff*. As he looked off the edge, he spied a hand *ax* sticking out of the cliff. They excavated the *site* and discovered the dwelling place of a man who had lived about 200,000 years ago!

Leakey continued his education. He received his Ph.D. degree from Cambridge. He taught, lectured, and did research in many of the colleges in England. In 1935, Louis married for the second time. He married Mary Nicol, who was as interested in early humans as Louis was.

When World War II broke out, Louis worked for British Military Intelligence in *Nairobi*,

Kenya. He had to stop his fossil-hunting. Mary continued along with their first son, *Jonathan.*

After World War II ended Leakey began again to search for the beginnings of humanity. He found many things, but none could be directly tied to the earliest people. Finally, in 1948, on an island in Lake *Victoria*, he found what he was looking for.



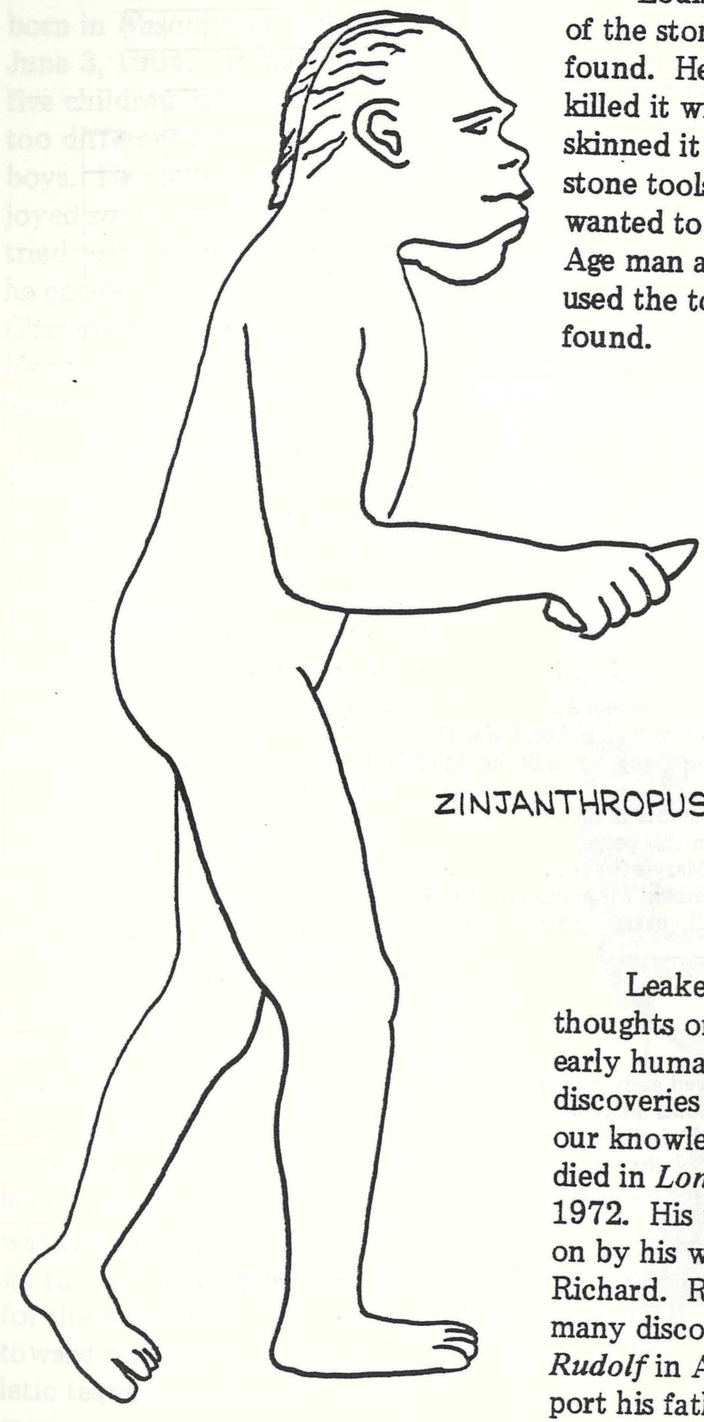
It was the skull of an ape-like creature that had lived twenty-five million to forty million years ago! Today most authorities think he was the common ancestor of both mankind and apes. At last people began to think about Leakey's theory that Africa was where we began, and not Asia.

The *Olduvai* Gorge in northern Tanzania is the site in which Leakey found the most artifacts. It is thirty-five miles long and was channeled by a stream. The stream cuts through sediment that covers the bed of a prehistoric lake. Leakey spent much of his time exploring the ravines. Often the temperature reached 110° F.

Leakey explored the area on his hands and knees. That way he could see any buried artifacts that he might not see if he were on his feet. This was hard work, and oftentimes money was scarce. Help came in 1960. Louis and Mary Leakey received a grant from the National Geographic Society. They now had money to expand their search.

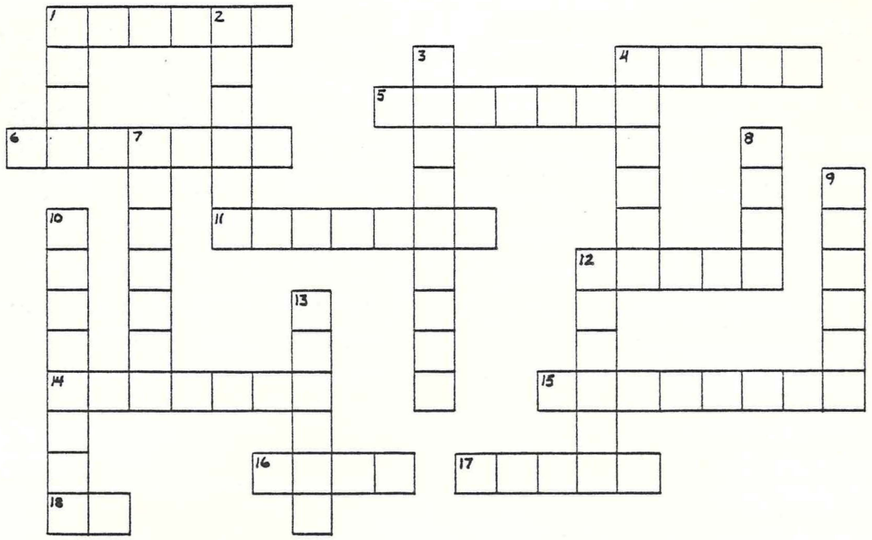
The Leakey family all worked in the Gorge. Jonathan, the eldest son, found the jaw of a prehistoric, giant baboon. ***Philip***, the youngest, found a giant ostrich fossil. *Richard*, the middle son, found the only known lower jaw of Zinjanthropus. This creature had huge teeth and a brain one-half the size of a modern man. He stood about five feet tall and walked upright.

Louis wanted to check some of the stone tools that they had found. He stalked a *gazelle* and killed it with his hands. Then he skinned it with the prehistoric stone tools they had found. He wanted to prove that a Stone Age man actually could have used the tools that they had found.



ZINJANTHROPUS

Leakey did much to change thoughts on the beginnings of early humans. His theories and discoveries have added much to our knowledge. Louis Leakey died in *London*, October 1, 1972. His work is being carried on by his wife and his son Richard. Richard has made many discoveries around Lake *Rudolf* in Africa that help support his father's theories.



ACROSS

1. Leakey was born on this continent.
4. Country in which Leakey was born.
5. Louis worked in this city during World War II.
6. Leakey killed this animal the way a Stone Age man might have done.
11. Leakey's middle son.
12. Louis was hurt playing this game.
14. The Leakeys explored this gorge.
15. _____ was Louis and Mary's first son.
16. A place where a settlement's remains are found.
17. Louis made his first discovery by almost falling off this.
18. Louis found a stone _____.

DOWN

1. Other scientists believed early humans started here.
2. W. E. _____ showed Louis many things.
3. Louis attended _____ University.
4. Louis joined the _____ Tribe.
7. Country Louis was sent to for his education.
8. Louis's second wife.
9. Leakey died in this city.
10. In 1948, on an island in Lake _____, Leakey made an important discovery.
12. Richard has made discoveries around Lake _____.
13. _____ is their youngest son.

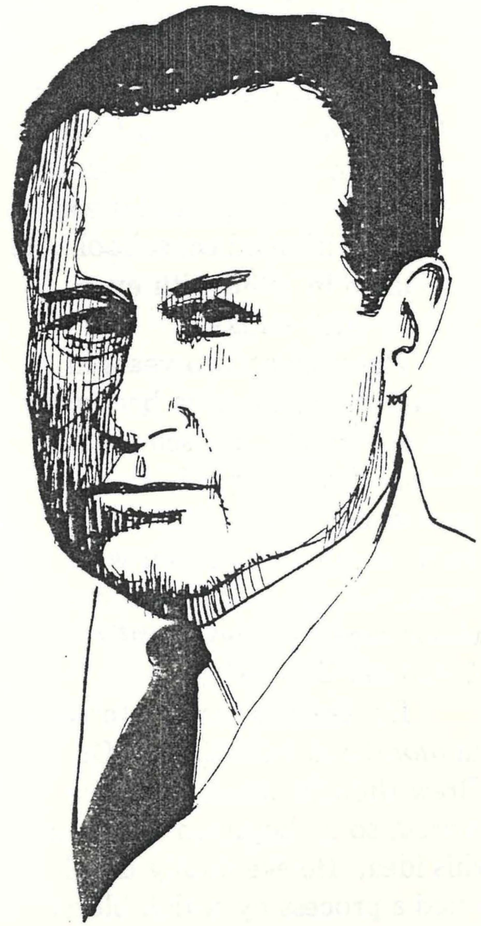
Charles Richard Drew

Charles Richard Drew was born in *Washington*, D.C., on June 3, 1904. He was one of five children. Charles was not too different from other young boys. He played hard and enjoyed *sports* of all kinds. He tried to be the best athlete that he could. One of the sports that Charles loved was *swimming*. He practiced hard and even won *medals* in swimming competition.

As Charles went on in school he earned good grades. Not only did he want to do well in his education, but he also had to keep good grades to continue playing sports. Charles did well in a variety of sports in high school. He starred in football, basketball, baseball, and track.

Charles graduated from high school and went to *Amherst* College. College was much like high school for Charles. He kept good grades and participated in every sport he could. He got a trophy as an outstanding athlete when he graduated from Amherst in 1926.

At this time Charles Drew became a *coach* at a small college in *Baltimore*, Maryland. He was still mainly interested in sports and what sports could do for the individual. He worked toward making successful athletic teams and healthy young men.

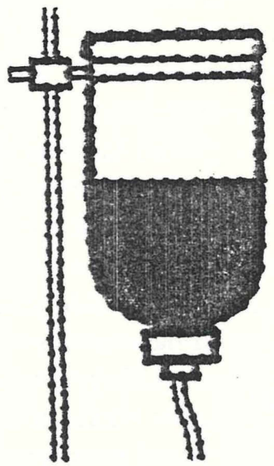


Then Charles Drew seemed to change. He was still interested in athletics, but he wanted to do something else with his life. Drew became interested in *medicine*. It was a tough decision, but Drew decided to leave his small college and enter medical school.

Drew went to *Montreal, Canada*. He entered medical school at *McGill* University. It was hard for Drew, but he found that he loved medicine. He made friends, one of which was John *Beatie*, with whom Charles worked on experiments. Almost before he knew it, Charles was through with medical school. He graduated in 1933 with extremely high marks.

Drew spent two years in special training before becoming a teacher in medical school at *Howard* University. In the process of being at Howard, Drew became fascinated with surgery. In order to learn more about surgery, Drew went to *Columbia* University.

Dr. Drew became interested in *blood* and its makeup. Dr. Drew thought blood could be *stored*, so he began to work on this idea. He eventually developed a process by which blood *plasma* could be saved until it was needed. With this process,



blood could even be sent to distant places if there was a need.

Dr. Drew's work with blood plasma helped both Great Britain and the United States during *World War II*. Less often did soldiers die because of lack of blood. Thousands of lives were saved thanks to Dr. Drew's "blood bank" for the American Red Cross.

After World War II, Drew returned to teaching at Howard University. He was also sent with other doctors to tour foreign countries to help them improve their health care.

The medical profession was shocked in 1950 when Charles Richard Drew died at the age of forty-five—he had contributed so much to the medical world in such a short time.

1. C _ _ _ _
2. H _ _ _ _ _ _
3. _ A _ _ _ _
4. _ _ _ R _ _
5. _ L _ _ _ _
6. _ E _ _ _ _ _ _
7. S _ _ _ _ _ _ _
8. _ _ _ _ R _ _ _
9. _ _ _ I _ _
10. C _ _ _ _ _ _ _
11. _ _ H _ _ _ _
12. _ _ A _ _ _
13. _ _ R _ _ _ _ _ _ _ _ _
14. _ _ _ _ D
15. _ _ D _ _ _
16. _ _ _ R _ _
17. _ _ _ _ _ _ _ _ E
18. W _ _ _ _ _ _ _ _ _ _

CLUES

1. Drew became a ____ in a small college.
2. Drew taught at ____ University.
3. Country in which Drew became a doctor.
4. Drew thought blood could be ____.
5. Drew worked out how blood ____ could be kept.
6. Drew studied ____.
7. Charles loved this sport.

8. City in which Drew went to medical school.
9. ____ University Medical School.
10. Drew went to ____ University to learn more about surgery.
11. After high school Drew went to ____.
12. John ____ was Drew's friend.
13. Saving blood was important in ____ ____ ____.
14. Drew is best remembered for his work with ____.

15. Charles won ____ in swimming.
16. As a young man, ____ interested Charles.
17. Drew worked as a coach in this city.
18. Drew was born in this city.

Rachel Carson

Rachel Carson was a gentle lady, but she was concerned about something. As a young girl, she used to take walks just to enjoy nature. She remembered how beautifully the *birds* used to sing on her walks. She loved to watch the patches of bright color flying from place to place. Now, as an older woman, she still liked her walks when time would permit. However, the birds were fewer in number than she remembered. What was happening to our birds, and what could she do to keep more birds from disappearing?

Rachel Carson was born in *Springdale, Pennsylvania*, on May 27, 1907. It was Rachel's *mother* who first walked with her outdoors and introduced her to the wonders of the natural world. Together they explored, discovering birds and insects that were fascinating.

In addition to her love of nature, Rachel liked to write. When it came time to enter Pennsylvania College for Women, Rachel thought she would become a *writer*. She changed her mind after taking a class in *science*. She went on to graduate with a science degree and then enroll in Johns Hopkins University to take more science courses. In 1931, she became a member of the Zoology staff at the University of Maryland.

Rachel Carson had another interest; it was the *sea*. She became a *marine* biologist. In 1936 she accepted a post with the United States Bureau of Fisheries. The Bureau was lucky to get her. Not only did she know marine biology, but she began to write bulletins and pamphlets for them.

The sea became more interesting to Carson, and she thought of a way to combine her two interests. She began work on a book that was called *Under the Sea-Wind*. Many people in the United States became aware of the wonders of the sea for the first time after reading her book. Parts of the book were even reprinted in magazines and other works.

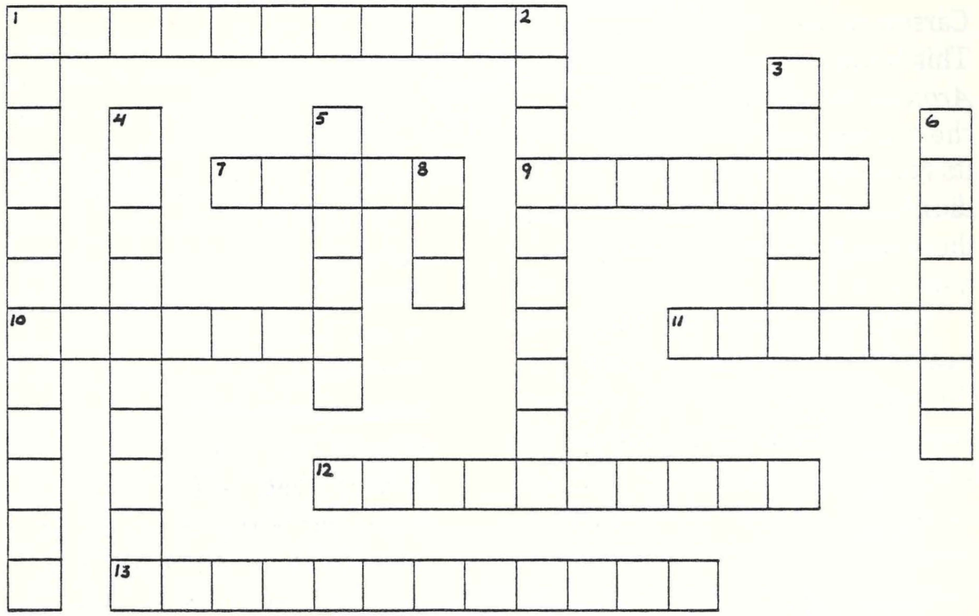
Even though World War II took much of her time, Rachel Carson wrote another book. This book was called *The Sea Around Us*. It was the story of the sea and our attempts to solve its mysteries. Even people who didn't really like science enjoyed the book because she wrote so well.

Rachel Carson won many awards with *The Sea Around Us*. One was the *Guggenheim* Fellowship, which gave her a year off from her job with money to live on. She was happy for this because she already had another book in mind. She had become concerned about the disappearing birds and wanted to do a book about it. It would take a lot of research, but people needed to be made aware of the problem.

Rachel Carson's last book, *Silent Spring*, was probably her most powerful one. She warned people of the dangers of *pesticides*. She pointed out that as *insects* were killed by pesticides so were the birds that ate the insects. She knew that all pesticides could not be done away with, but we had to become aware of what we were doing! If the balance in nature was destroyed, then many animals would not have food to eat, or would be destroyed along with the insects. As the title of the book implies, if this occurred we would have a silent spring each year. The birds would not sing, and frogs and other animals would not contribute their voices because they would be dead.

This book set off a conflict between nature lovers and *farmers*. The farmers felt they had to use pesticides to keep insects from eating their crops. The nature lovers did not want the animals that lived off insects to be destroyed, or the problem would get worse as nature became more unbalanced. The book also led to more research into pesticides and to greater attempts to try to find some that are not so harmful to animals.

The controversy continues, but Rachel Carson is no longer alive to be involved. She died April 14, 1964, in *Silver Spring*, Maryland.



ACROSS

1. *The* ____ ____ ____ told of our attempts to solve the mystery of the sea.
7. Rachel Carson became concerned about the loss of ____.
9. Things killed with pesticides.
10. In college Rachel majored in ____.
11. Carson became a ____ biologist.
12. The ____ Fellowship was awarded to Carson.
13. City in which Carson died.

DOWN

1. Last book written by Carson.
2. City in which Rachel Carson was born.
3. Person who got Rachel interested in nature.
4. Poisons used to kill things that eat crops.
5. Carson also became a ____.
6. The ____ wanted to use pesticides.
8. Carson wrote books about the ____.

Dorothy Crowfoot Hodgkin

Dorothy Crowfoot was the daughter of an *archaeologist*. Her father and mother were in *Cairo, Egypt,* in 1910. He was working with other English archaeologists on the wonders to be found in Egypt. Mrs. Crowfoot always went with her husband on his travels. This time, on May 10, Dorothy was born!

Dorothy's family was always close. They traveled wherever there were things of interest to Dorothy's father. Dorothy, however, had to leave her family when it came time for her education. Both parents wanted her educated in *England,* where they had been educated. Dorothy attended Somerville College at *Oxford,* where she studied with the scientist Robert *Robinson*. She graduated in 1932. Still her education was not complete. She went to *Cambridge* University for more work. There, in 1937, she got her Ph.D. in *biochemistry*.

Before she graduated with a Ph.D., Dorothy was required to do research that had not been done before. She studied the digestive enzyme called *pepsin*. She converted the pepsin into crystal form and then studied the X-ray diffraction of the crystals. When light or X ray is diffracted, it is sent through a crystal and the rays are spread out. The light becomes colored *bands* that show the makeup of the crystal.

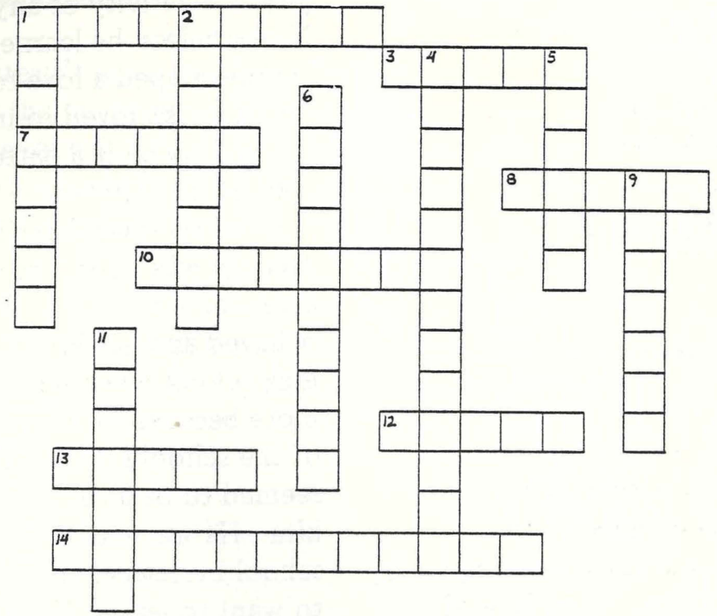
This study increased Dorothy's interest. She wanted to find and study complex organic structures. One of the ways she was interested in studying them was through X-ray diffraction.

During World War II, Dorothy began to work with *penicillin*. Dorothy, who had become Mrs. Hodgkin when she married, wanted to find out the structure of penicillin. Mrs. Hodgkin approached the problem a new way. She gathered information using X rays as she had in the past. She put the X ray information into an electronic *computer*. This was the first time that an electronic computer had been used in a biochemical problem. Today we have become aware that com-

puters are capable of doing many things much faster than humans. During World War II, however, people were still unsure of what computers could do. Hodgkin's computer work helped a great deal in finding the basic structure of penicillin. It also showed others what the computer was able to do in the field of biochemistry.

During the 1950s Hodgkin tackled another problem. *Vitamin* B_{12} had recently been isolated. She decided to find out the molecular structure of vitamin B_{12}. A *molecule* of B_{12} was four times as large as penicillin. Its structure was unusual. Again Hodgkin used a computer to help. Even so, it took years of research and computer help to work out the structure in full detail.

In 1964, Dorothy Hodgkin was awarded the *Nobel* Prize in Chemistry. She thus received the recognition she deserved for her dedication to the field of biochemistry.



ACROSS

1. Dorothy got her Ph.D. from ____ University.
3. City in which Dorothy was born.
7. Dorothy worked with this digestive enzyme.
8. Hodgkin won the ____ Prize.
10. A ____ of B_{12} is four times the size of penicillin.
12. Country in which Dorothy was born.
13. When light becomes diffracted it produces ____ of colors.
14. Hodgkin's field of study.

DOWN

1. Hodgkin used an electronic ____ to help her in her research.
2. At Oxford Dorothy studied with Robert ____.
4. Dorothy's father was an ____.
5. Somerville College is in this city.
6. Hodgkin wanted to find the structure of ____.
9. Dorothy went to school in this country.
11. B_{12} is a ____.

Jacques Cousteau

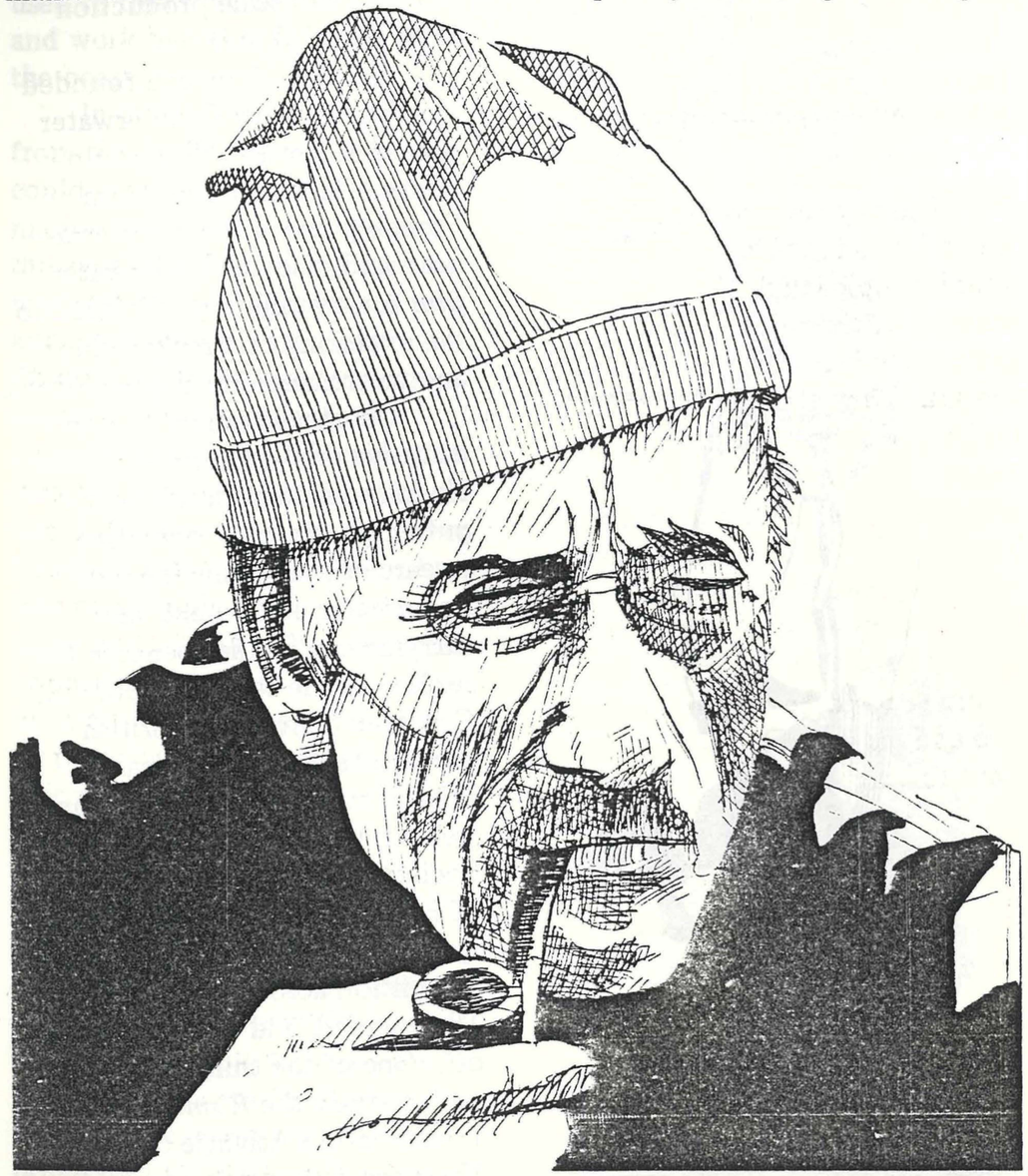
The day was warm and the water looked inviting. The young couple laughed at the thought of their day exploring the beauty below the surface of the sea. They strapped on their tanks, and soon were in the water. They would be able to stay under the water a long time. They could have such a wonderful experience because of Jacques Cousteau. He had invented the *Aqua-Lung,* which enables the swimmer to go below the surface and have freedom of movement to swim and explore.

Jacques Cousteau was born on June 11, 1910, in a little town in *France.* His father was a *lawyer*, employed by an American millionaire who liked to travel. The Cousteau family traveled a great deal and never had a permanent home. Jacques was a sickly boy. He was warned by his doctors to avoid strenuous physical activity of any kind. Nevertheless, he learned to *swim* and developed a love for the sea. Jacques also loved to invent things. He built a battery-powered car at thirteen.

In his formal schooling Jacques was poor. He did not care about studying. He misbehaved and got kicked out of high school when he was a sophomore because he broke seventeen of the school's windows. This seemed to be a turning point for him. He was sent to a strict school in *Alsace,* and he began to want to learn. He went on to graduate second in his class in France's *Naval* Academy.

In the *Navy* Cousteau went around the world on a training cruise, spent time in a naval base in Shanghai, and helped map the coast of Indochina. Then he entered the Naval aviation school. Just before he got his *pilot*'s wings he broke both *arms* in an automobile crash. When he returned to active duty, he went to the Mediterranean coast. There he began swimming again to strengthen his arms. He had been given a pair of underwater *goggles* used by pearl divers in the South Seas. He became fascinated with the world beneath the sea. This caused him to begin work on an apparatus that would let humans swim underwater with complete freedom.

Cousteau's work was interrupted by the outbreak of World War II. He served in the area of France not occupied by the Germans. Cousteau also worked as a member of the French Underground *Resistance.* The Germans regarded Cousteau as a harmless eccentric, and he was permitted to continue his experiments. Late in 1942, Cousteau was helped by Emile *Gagnon.* Gagnon



had invented an automatic gas-feeding *valve*, which was what Cousteau needed for his underwater breathing apparatus. Cousteau succeeded in developing the first Aqua-Lung. It was put into full scale production after World War II.

In 1946 Cousteau founded the French Navy's Underwater Research Group. This group cleared German mines from French ports in the Mediterranean and made an underwater *film* for the military. This led to the exploring of wrecked ships and to archaeological expeditions.

Cousteau wanted to continue his explorations of the sea. He founded organizations that put emphasis upon operating research ships, designing new underwater equipment, and carrying out studies beneath the surface of the seas. In 1951-52, Cousteau converted a British *mine-sweeper* into a research ship, named *Calypso*. Then he went to the National Geographic Society and the French Academy of Sciences. He wanted them to sponsor a four-year oceanographic expedition across the world's seas. They agreed, and the *Calypso* was off. One of the things they did was to study the *Romanche* Trench in the Atlantic *Ocean*. Their specially designed equipment allowed the first view of the bottom of an ocean trench.

Cousteau and Auguste *Piccard* worked with French Naval engineers to construct the first *bathyscaphes*. These are used to find how people can live and work below the surface of the ocean.

In 1956 Cousteau resigned from the French Navy so he could devote full time to his marine interests. He has become the head of a diverse and far-reaching body of enterprises known as the Cousteau group. These sixteen organizations are engaged in activities such as oceanographic research, manufacture of diving gear, filmmaking, television, and ecology. Cousteau Cousteau's book, *Silent World*, told of his underwater experiences up to 1953. Then he wrote *Living Sea*, which told of his life to 1963. These became so popular that Cousteau has continued writing about the wonders of the sea.

Television and Jacques Cousteau seemed made for each other. In 1966 *The World of Jacques Cousteau* was presented as a National Geographic Special. Millions of people watched the program and were fascinated. It was such a success that he began doing four programs a year about his marine explorations and expeditions. Many people began to look forward to each new adventure from the *Calypso*. They were again fascinated with the four programs devoted to exploing the Antarctic.

Cousteau brings the world of oceans to people at home and educates and entertains. He also shows what we are doing to destroy the ocean through pollution. He is a scientist who is trying to protect and preserve the oceans of the world.

D R A C C I P I L O T M
L R E Y W A L E N I M L
R E O N A E C O V M I I
O S E M A N A V A L W F
W I N A A Q U A L U N G
T S Q R U N N A V Y E A
N T F M O W C A E T C G
E A S S W I M H I M A N
L N E G O G G L E S S O
I C A L Y P S O Y A L N
S E H P A C S Y H T A B

_____ 1. Country in which Cousteau was born.
_____ 2. Cousteau invented the ____ ____.
_____ 3. Cousteau worked with the French underground ____.
_____ 4. Name of Cousteau's first book.
_____ 5. Cousteau went to France's ____ Academy.
_____ 6. Cousteau broke both of his ____.
_____ 7. Cousteau went to school in ____.
_____ 8. Cousteau's father was a ____.
_____ 9. Emile ____ helped Cousteau with his invention.
_____ 10. Cousteau got ____ from pearl divers.
_____ 11. Cousteau needed a gas-feeding ____.
_____ 12. Name of research ship.
_____ 13. They explored the ____ trench.
_____ 14. Auguste ____ helped Cousteau with an invention.
_____ 15. The *Calypso* was a ____-sweeper.
_____ 16. Cousteau was in a crash before he got his ____'s wings.
_____ 17. Cousteau learned to ____ to become healthier.
_____ 18. Branch of military Cousteau was in.
_____ 19. The ____ allow people to live and work below the surface of the ocean.
_____ 20. Another Cousteau book was *Living* ____.
_____ 21. Cousteau's group explored the Atlantic ____.
_____ 22. Right after World War II, Cousteau made an underwater ____.

Wernher Von Braun

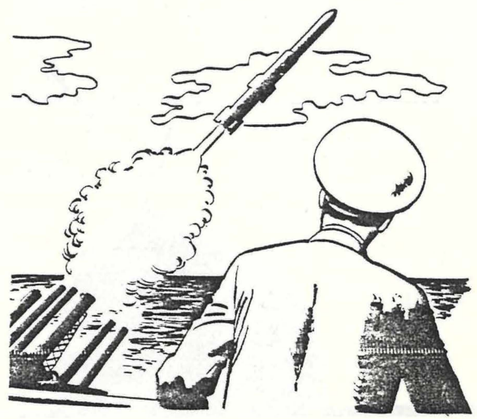
Wernher Von Braun was born March 23, 1912, in Wirsitz, *Germany*. His father was a government official, so the family moved a good deal. Wernher was educated in Zurich, Switzerland, and in *Berlin*, Germany.

At eighteen Von Braun read an article about traveling to the *moon*. This idea fascinated him. He continued his education, getting his Ph.D. in 1934 from the University of Berlin. Von Braun decided to make rocketry his lifework. He did not just choose this field blindly. He had already worked with rocks and rocket fuel. And he had already fired some of his own rockets, one of which had reached an altitude of a mile.

In 1933 Adolf Hitler came to power in Germany. He had hopes of taking over the world. Hitler became interested in rocket research, too. In 1936 a rocket research center in *Peenemunde* was being built. By 1938 they had put together a rocket with an eleven mile range.

Von Braun joined Hitler's Nazi party in 1940. He became one of the leading rocket scitentists for Hitler. By 1942 a missile was built that carried its own fuel and oxygen. Von Braun was the leader of the group that developed this missile.

Von Braun continued his research. In 1944 the Germans were using his V-2 rocket to bomb London, England. Many English people died in the Second World War because of the V-2 rockets. More lives might have been lost and the V-2 completed earlier than 1944, but Hitler wouldn't leave Von Braun alone. Hitler placed Heinrich *Himmler* in charge of the rocket program.



Himmler did not get along with Von Braun. Himmler had Von Braun arrested! Von Braun was released, but he was not happy. He did not like the V-2 being used to kill people.

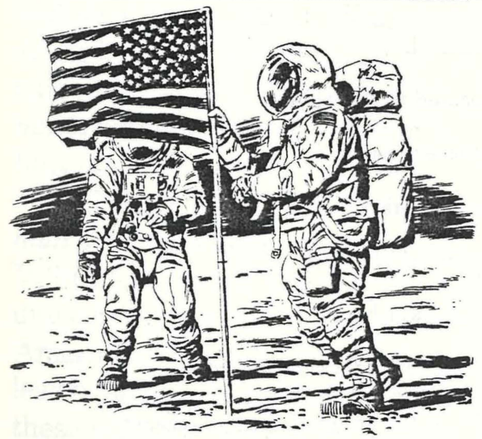
As the end of World War II grew near, Von Braun and many of his scientific friends escaped to the West. They surrendered to the *Americans* rather than be taken by Russian troops. The Americans brought Von Braun to the United States, where he began to work for us.

Along with Von Braun came many V-2 rockets. He showed officials how to use them and helped design rocket facilities in the United States. Much of his work in the United States was secret. He became the leader of a group at *Huntsville, Alabama*. They worked in America's satellite program.

America's first satellite,

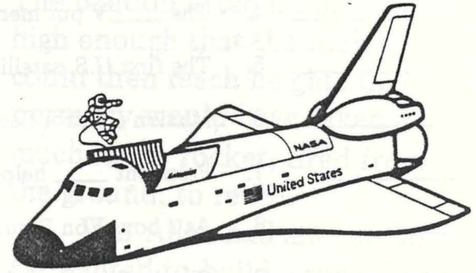
Explorer I, was put into orbit on January 31, 1958. Von Braun became the leader and salesman of the space program. It was President John F. *Kennedy* who gave Von Braun the "O.K." to try to build a rocket that could put a man on the moon. Von Braun's group went to work at once. The result was the *Saturn* V.

It was a great day for Von Braun on July 20, 1969. That day he was at Mission Control Center in *Houston* when Neil Armstrong and Edwin Aldrin planted the American flag on the moon. Von Braun's dream was complete, except that he wanted to go too.



Von Braun continued to work toward easy, less expensive travel to the moon. He figured he would be about sixty-eight before this would be possible. Sixty-eight was old, but not too old to go to the moon. He even got his wife *Maria's* permission to go. That would have really been the answer to his dream

Von Braun never got the chance. He did work on the space *shuttle* that would make his dream come true. However, he developed medical problems. Then he was told he had cancer. He had an operation in 1975, but he knew he would never be completely well again. He continued to advise, but he could no longer put in the long hours he once had.



Wernher Von Braun died of cancer on June 16, 1978, at the age of sixty-five. He had been the main force behind the United States space program. Even if he didn't get to the moon, he did live to see his dream of men on the moon come true!

E D N U M E N E E P
K A N A M A B A L A
K M R S H U T T L E
E E U A I R A M I X
N R T X M O O N V P
N I A B M I T R S L
E C S Y L O T S T O
D A D B E R L I N R
Y N A M R E G O U E
B S N O T S U O H R

_____ 1. Von Braun's wife.

_____ 2. Country in which Von Braun was born.

_____ 3. At his death Von Braun was working on a space ____.

_____ 4. The ____V put men on the moon.

_____ 5. The first U.S. satellite was ____ I.

_____ 6. Mission Control Center is located in this city.

_____ 7. President ____ helped the space program.

_____ 8. As a boy, Von Braun dreamed of travel to the ____.

_____ 9. City in Germany where Von Braun attended school.

_____ 10. The German rocket center was built here.

_____ 11. Heinrich ____ was put in charge of the rocket program.

_____ 12. Von Braun became the leader of the group at ____, Alabama.

_____ 13. Von Braun and other scientists surrendered to the ____.

_____ 14. State in which the first satellite was worked on.

James Alfred Van Allen

James Van Allen was born in Mount Pleasant, *Iowa*, on September 7, 1914. He grew up and attended college in Iowa. In 1939 he received his Ph.D. in *physics* from the State University of Iowa.

Van Allen's inventive mind came to be needed during World War II. He developed the proximity *fuze*. This fuze could be attached to an explosive weapon. When the explosive weapon came near the target, radio waves would become strong enough to set off the explosive. This meant that direct hits were not necessary, which improved the efficiency of anti-aircraft fire.

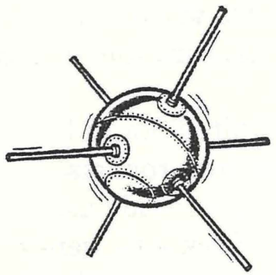
The work with the proximity fuze yielded some useful technical information. Van Allen had to make the fuze extremely small. This use of ***miniaturization*** would be important later.

During World War II, *German* scientists developed the V-2 rocket. After the war the unused V-2's were taken by the Americans. Van Allen was the leader of the group that studied these rockets. Van Allen's group put equipment on the V-2 rockets that was designed to test the amount of *cosmic* rays in the air. They were able to test for these rays up to 100 miles above the earth. This is where Van Allen's use of miniaturization helped him.

The United States began to design their own rockets. In 1952 Van Allen made use of rockoons. Rockoons were a combination rocket and balloon. The balloon lifted a small rocket high enough that the rocket could then reach heights that normally would have taken a much larger rocket, fired from the ground, to reach.

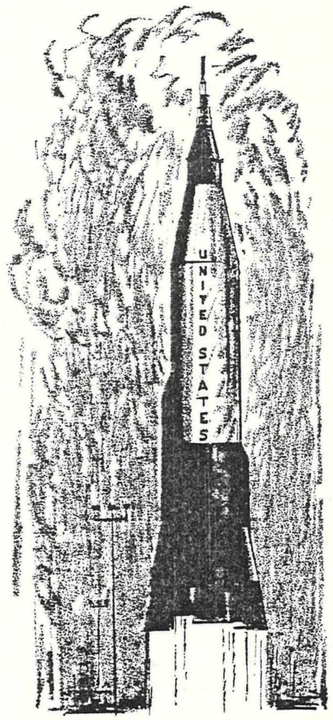
Van Allen had another idea. He wanted to build a rocket that could carry a lot of equipment. He wanted this rocket shot far enough to put it into *orbit* around the earth. Then the rocket could circle the earth sending information back to us. The government finally agreed. The rocket, or artificial *satellite*, was to be launched during the International Geophysical Year.

The International Geophysical Year would run from July 1, 1957 to December 31, 1958. During this time the nations of the world would study the earth and its atmosphere. The Soviet Union took a major part in the International Geophysicial Year. They announced that they would also put a satellite into space. On October 4, 1957, *Sputnik* I



was launched into space. A month later Sputnik II, carrying a dog, was put into space.

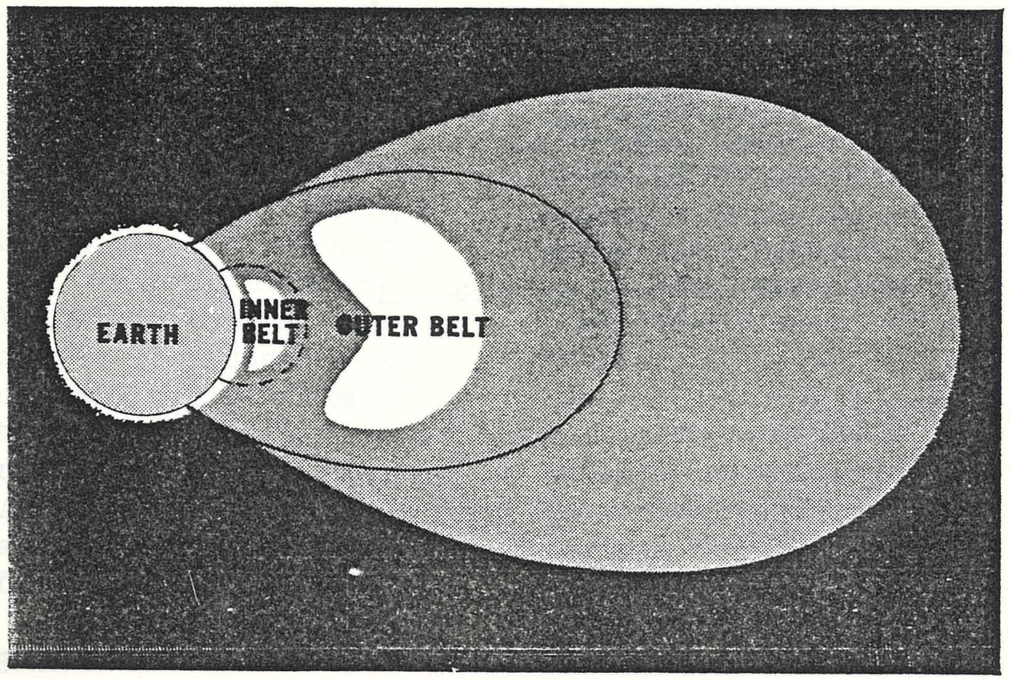
This was during the Cold War, and the United States panicked. They did not want the Soviet Union getting the jump on the United States in space exploration. Van Allen was called on to increase American efforts to put its own satellite into orbit. On January 31, 1958, *Explorer I*, the United States satellite, was put into orbit. It was much smaller than Sputnik I, but with Van Allen's miniaturization it packed a lot of instruments.

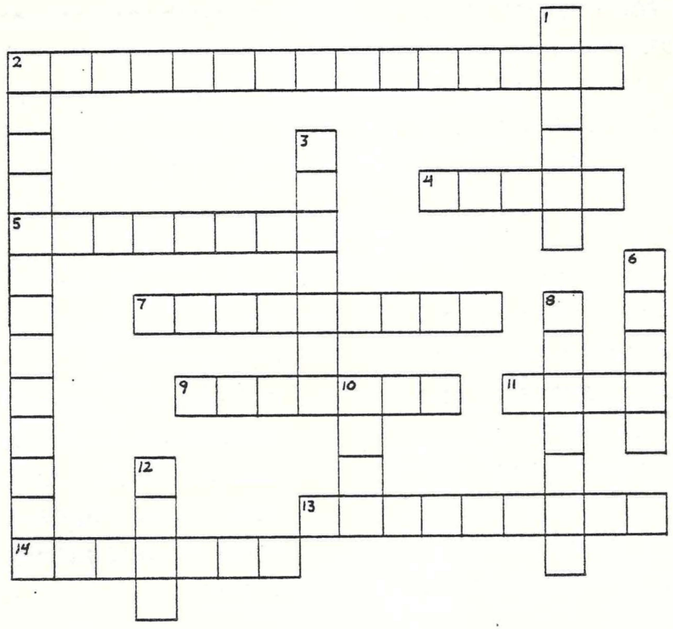


Van Allen had kept his interest in cosmic rays. The Explorer I carried instruments to measure them. The instruments measured extremely high amounts of cosmic rays and then went dead. Van Allen began to suspect that the instruments couldn't register high enough. He designed an instrument with a *lead* shield that would accept only some of the rays. He put this instrument into Explorer IV. The tests proved that there was more high-energy radiation in nearby space than anyone suspected. This belt of radiation is popularly called the Van Allen *Radiation* Belt. Its formal name is the *magnetosphere.*

Van Allen found that the high-energy belt encircled the earth at the *equator*. It curved toward the polar regions. The polar regions, however, are almost free of the radiation. Van Allen went on to other high altitude tests. An atomic bomb was even exploded several hundred miles above the earth's surface. The particles spread out from the bomb in such a way that proved that the earth's magnetic field was the cause of the forming of the magnetosphere.

Other high altitude tests followed. Some of these tests produced changes in the magnetosphere. Some scientists did not like the changes. Many were worried about the problem of manned flights into space. It has been found, however, that humans are reasonably safe on these flights.





ACROSS

2. Van Allen used his talent for ____ to get all the instruments into the space ship.
4. Van Allen wanted a rocket to ____ the earth and send back information.
5. ____ I was launched January 31, 1958.
7. The Van Allen ____ Belt circles the earth.
9. Van Allen graduated with a degree in ____.
11. Van Allen developed the proximity ____.
13. The Soviet Union launched the first artificial ____.
14. The Van Allen Belt is stronger around the ____.

DOWN

1. Van Allen was interested in ____ rays.
2. Formal name for the Van Allen Belt.
3. The ____ developed the V-2.
6. Van Allen's first name.
8. The Soviet Union launched ____ I.
10. State in which Van Allen was born.
12. Van Allen put a ____ shield around the instrument used to count rays in space.

Francis Harry Compton Crick

Crick was born in *Northampton, England,* on June 8, 1916. He was a brilliant man. He graduated from University College in *London* as a physicist. During World War II he worked on the development of *radar*. This helped the English spot the German planes as they came across the English Channel to bomb London and other cities. He was also involved in the development of *mines* during the Second World War.

After the war years, Crick returned to school. He received his Ph.D. from *Cambridge* University in 1953. Crick had become interested in another field, however. Many Cambridge students had turned to biochemistry. Crick was one of these students. Together they helped establish the science of *molecular* biology. Molecular biology is a joining of biology, chemistry, and physics.

During the Second World War, biochemistry had greatly changed. New things had been discovered that made it easier to separate complex biochemical mixtures into their different parts. Another discovery led to the ability to separate one compound from another.

Biochemists had also begun to realize that *acids* in the nucleus, and not proteins, were the things that carried physical characteristics. It was the deoxyribonucleic acids, called DNA, of the *chromosomes* that were the key chemicals of life. As soon as this was discovered, the scientists wanted to know more about the make up of the molecular of DNA. They soon found that biochemistry couldn't answer their questions. They needed to know physics, too.

It was these new ideas that interested Crick and the other students at Cambridge. Crick turned from physics to molecular biology. He was joined by an American named *Watson*. Together, Crick and Watson studied the work of *Wilkins,* another scientist, who used X rays to separate molecules. In their search to understand the DNA molecule, Crick and Watson

studied the work of other scientists, too. Many of these scientists thought that the nucleic acids were constructed like fibrous *proteins*. Crick wanted to be sure. Fibrous proteins existed in the form of a *helix*. The helix shape is like a spiral staircase.

Earlier scientists had discovered that chromosomes were the key to heredity. Now it was understood that the chromosome was a string of DNA molecules.

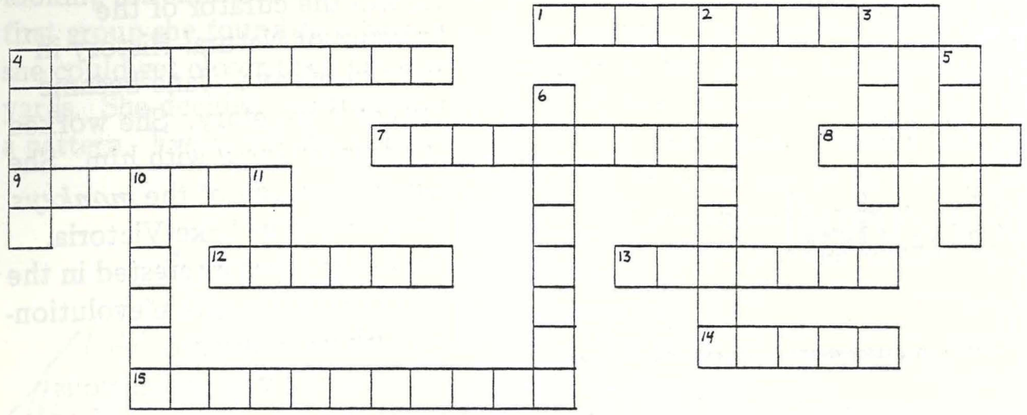
Crick and Watson worked and studied. They read that the *DNA* molecule had four ***nitrogenous*** bases—adenine, guanine, thymine, and cytosine. Still they worked and studied. Finally, in 1953, they published a paper on their findings. One of the things they said was that the DNA molecule consisted of a double helix. They also showed the relationships within the double helix. They showed which nitrogenous bases worked with each other, and they also described how the helixes duplicated themselves.

Other scientists read their paper with wonder. They began to redo the research of Crick and Watson. After ten years of study in many parts of the world, biochemists have accepted the work of Crick and Watson on the structure of the DNA molecule.

In 1962, Crick, Watson, and Wilkins shared the *Nobel* Prize in medicine and physiology. That same year the Nobel Prize in Chemistry went to another group from Cambridge. The people who who had pioneered molecular biology had been recognized by the world.

Crick became a scientist that people wanted to listen to. He came to the United States. He lectured at Harvard, Rockefeller Institute, and Johns Hopkins, telling other scientists about the structure and function of the DNA molecule.

Still Crick has not given up on the mysteries of the DNA molecule. He and other scientists want to know how protein is formed by DNA. When this is known, the so-called genetic code will be broken.



ACROSS

1. Early scientists thought the ____ was the key to life.
4. City in which Crick was born.
7. Crick got his Ph.D. from ____ University.
8. The ____ shape is like a spiral staircase.
9. Country in which Crick was born.
12. ____ worked with Crick.
13. ____ used X rays to separate molecules.
14. This device helped the English spot German planes.
15. The DNA molecule has four ____ bases.

DOWN

2. Crick and others established ____ biology.
3. Crick worked on the development of ____ during World War II.
4. Crick won the ____ Prize.
5. Scientists found that ____ in the nucleus carried physical characteristics.
6. Fibrous ____ are in a helix shape.
10. University College is located in this city.
11. Crick worked to understand the ____ molecule.

Jane Goodall

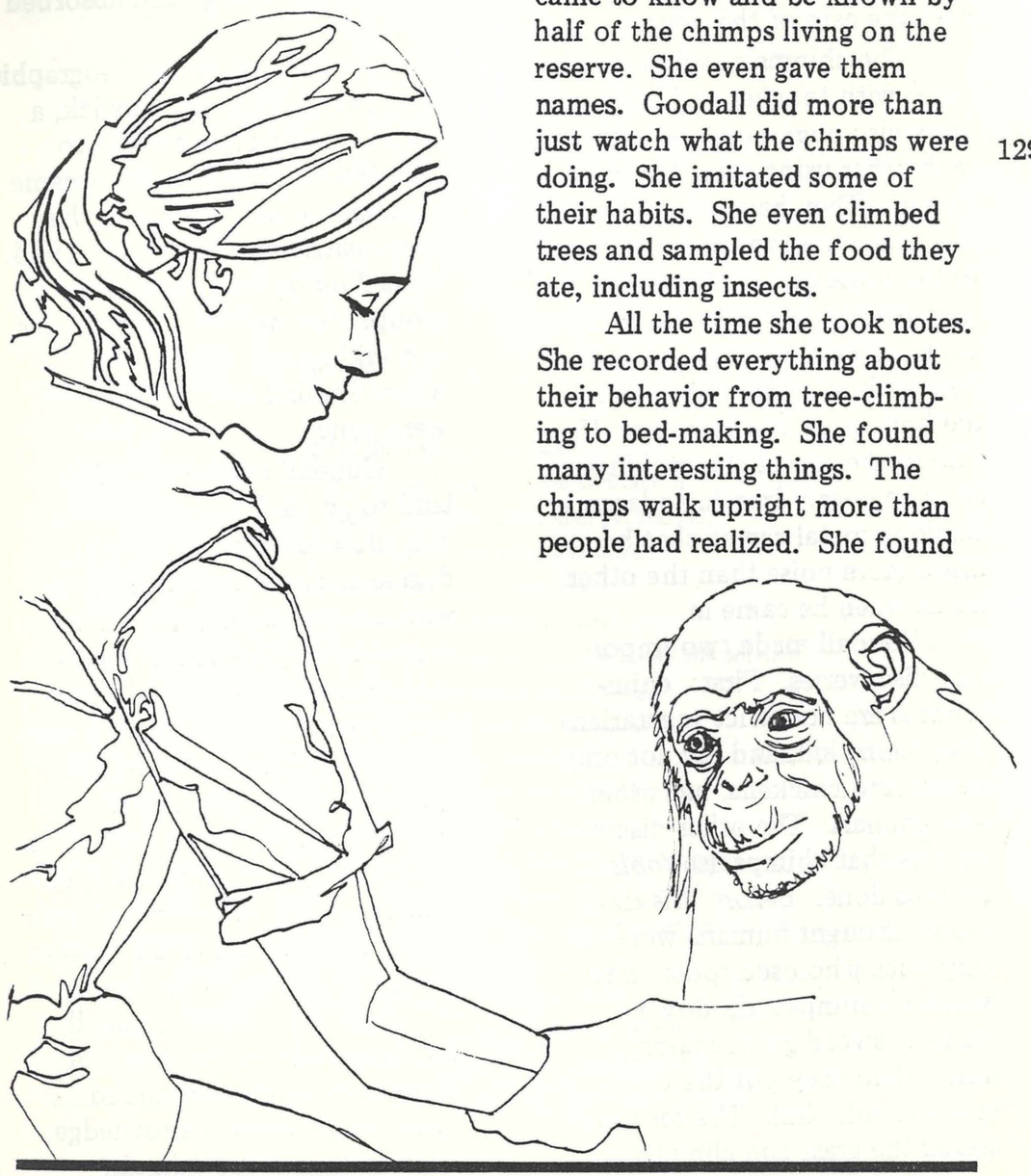
Jane Goodall was born in *London, England,* on March 4, 1934. As she was growing up. Jane became interested in animals of all kinds. She approached animals differently than other children do. She bought notebooks and made *notes* on what she saw animals doing. She soon knew the habits of the local birds and animals. When she had money, she spent it on zoology books. These books told her more of the things she wanted to know. She also began to dream of the day when she could go to *Africa* to study the animals there.

She left school at eighteen and went to work. She began to save her money. Jane still had her dream of going to Africa. A school friend of Jane's invited her to come to *Kenya.* Jane jumped at the chance. A month after she arrived she met Dr. Louis *Leakey*, the famous anthropologist and paleontologist. He was the curator of the Museum of Natural History in Nairobi, Kenya. Jane became Leakey's secretary. She worked at Olduvai *Gorge* with him. She also did a study of the *monkeys* on an island in Lake Victoria. Dr. Leakey was interested in the monkeys as a possible evolutionary link with humans.

Leakey was also curious about the behavior of the *chimpanzee.* The champanzee is an anthropoid ape. They are apparently closer to humans in intelligence than is the *gorilla.* Since they are less fierce than the gorilla and more teachable, they are often used in laboratories for experiments.

Leakey felt that the chimpanzee should be studied more closely. No one had thoroughly examined the chimpanzee in its natural setting. Henry *Nissen* had studied them in French Guinea for only two and a half months, which wasn't enough. Leakey wanted Jane to go to a game reserve in *Tanzania* to observe them at length.

Goodall was interested in Leakey's project. Money was a problem, however. She returned to England to work and to try to get backing for the study. In June, 1960, she set up her camp on Lake *Tanganyika* and began looking for chimpanzees. The first group she found fled before she could get closer than 500 yards. She decided to establish a pattern. Every day she got up



early and went to their feeding grounds. They gradually grew used to her and by the end of a year they allowed her to come within thirty feet of them. She came to know and be known by half of the chimps living on the reserve. She even gave them names. Goodall did more than just watch what the chimps were doing. She imitated some of their habits. She even climbed trees and sampled the food they ate, including insects.

All the time she took notes. She recorded everything about their behavior from tree-climbing to bed-making. She found many interesting things. The chimps walk upright more than people had realized. She found

there was no sexual jealousy among the chimps, and that the male has no part in the family life. The tie between mother and child is strong, and if the mother dies an older child takes over the care of the young.

The chimps comfort each other with touches and hugs.
130 They also *communicate* with each other using some twenty sounds. They have a social *rank*. The males are ranked according to the noise and performance they make when they enter the group at feeding times. Goodall observed one male who was at the bottom of the rankings. He rose to the top of the rankings after he began dragging a large, clanking metal can so that he made more noise than the other males when he came in.

Goodall made two important discoveries. First: chimpanzees are not strict vegetarians. They *hunt*, kill, and eat not only insects and chickens, but other wild animals. The other discovery was that chimps use *tools* to get jobs done. Before this time, people thought humans were the only ones who used tools. She watched chimps strip down a blade of sword grass, making it thin. Then they put the blade into a termite hill. The termites attack the grass and cling to it. The chimps then used the blade as an eating utensil. She also saw chimps chew leaves before using them to get water out of rock crevices. The chewed leaves acted like a sponge and absorbed water.

In 1962 National Geographic sent Baron *Hugo* van Lawick, a wild animal photographer, to film Goodall's work. He became a partner in her work, and they were married on March 28, 1964. Edna *Koning* also joined the group. She worked typing notes and taking care of the place when Goodall and her husband were gone.

Goodall returned to England to go back to school. She was allowed to get her Ph.D. degree at *Cambridge* University without first taking the earlier degrees. Only eight other people in the history of Cambridge have been allowed such an honor.

Goodall and her husband had a son on March, 1967. Young Hugo became a kind of an experiment, too. Like the chimpanzee young, he was raised with a close relationship to his mother for the first years of his life.

Jane van Lawick-Goodall has given years to the study of chimpanzees. She has added much to the world's knowledge of these interesting animals.

C O M M U N I C A T E A
H A E N G L A N D A T L
I C M O O L N O D N O L
M I R B A Y N E K Z G I
P S A F R I C A Z A U R
A L N Y N I S S E N H O
N O K I N G D E I I C G
Z O K O N I N G T A H O
E T Y E K N O M E O U R
E L E A K E Y L O U N G
S A K I Y N A G N A T E

_____ 1. Goodall set up camp on Lake ____.
_____ 2. Goodall studied the ____ on an island in Lake Victoria.
_____ 3. Dr. Louis ____ helped Goodall get started.
_____ 4. Country in which Goodall was born.
_____ 5. Goodall went to ____ University.
_____ 6. First name of Goodall's husband.
_____ 7. Goodall wanted to go to ____ to study the animals.
_____ 8. Animals Goodall studied for so long.
_____ 9. Dr. Leakey worked in Olduvai ____.
_____ 10. As part of her study, Goodall took ____ on animal behavior.
_____ 11. Chimpanzees ____ and eat other animals.
_____ 12. City in which Goodall was born.
_____ 13. Goodall visited a friend living in this country.
_____ 14. Henry ____ studied chimps for a short time.
_____ 15. The game reserve in which Goodall studied is in this country.
_____ 16. Chimps use twenty sounds to ____.
_____ 17. Chimps use ____ to get jobs done.
_____ 18. There is social _____ among the chimps.
_____ 19. The chimpanzee is easier to train than the ____.
_____ 20. Edna ____ helped Goodall take notes and type.

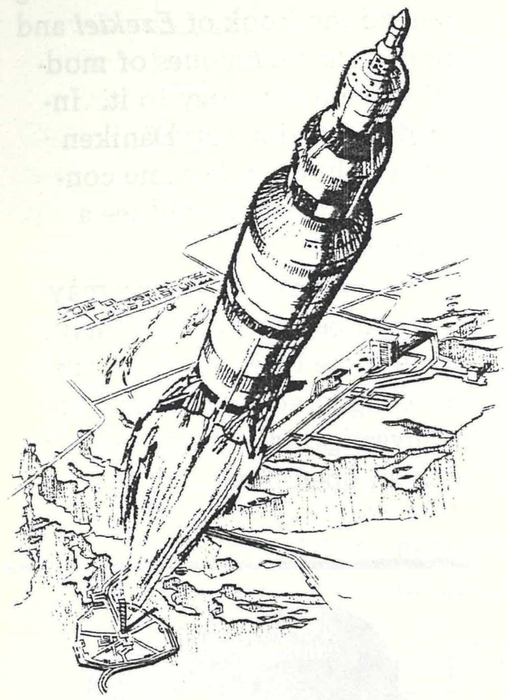
Erich von Däniken

There are many things we do not understand about our planet. For example, there are monuments built by ancient people that have no obvious purpose. How did they construct some of these huge monuments? What was the reason for them? Archaeologists and anthropologists have looked at these monuments and have come up with possible answers. Von Däniken has also looked at them. He has come up with a totally different explanation. It is von Däniken's theory that the earth was visited by beings from outer *space*. These beings helped the people on earth from time to time, for reasons still unclear to us.

Erich von Däniken was born in *Switzerland* on April 14, 1935. Erich was a *Catholic* and was sent to Catholic schools. Erich has said that his Catholic background first caused him to become involved with his theories. He once asked the priests, who were his teachers, what to do about some of his questions about Christianity. They told him to read the *Old Testament*. He did, and he found "inconsistencies" with what he had been taught. He read *Genesis* 1:26—"Let us make man in our own image." He also read Genesis 6:2—"The sons of the gods saw that the daughters of men were beautiful; so they took for themselves such women as they chose." But he had been taught about one God, not many. Who were these "gods" that were found in the Bible?

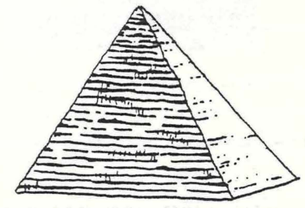
Von Däniken left school and worked in hotels. His work was seasonal, which gave him time to spend reading and traveling. When he studied *legends* and myths from around the world, he began to see that they were basically the same. In von Däniken's words, "The gods have come down from the sky, often with loud noise and in fiery vehicles. They created man, went back to the sky, and promised to return."

At first von Däniken did nothing with his theories. Then space flights by the United States and the Soviet Union occurred. With this background, people



were ready for his ideas. Von Däniken began writing magazine articles. Then he wrote a *book*. In the United States it was called *Chariots of the Gods?* In the book, von Daniken claimed that earth was visited by men from outer space. These men destroyed part of mankind and produced a new kind, perhaps the first homo sapiens. This idea shatters the basis for many ideas held by scientists. The book was extremely popular.

Next he wrote *Gods from Outer Space: Return to the Stars*. In this book he backed up his theories with oddities from various cultures. For example, the temples of the ancient Mayans and the Egyptian pyramids are so much alike, and yet there was no connection between the cultures. They were separated by thousands of miles of water.



Egyptian

Mayan

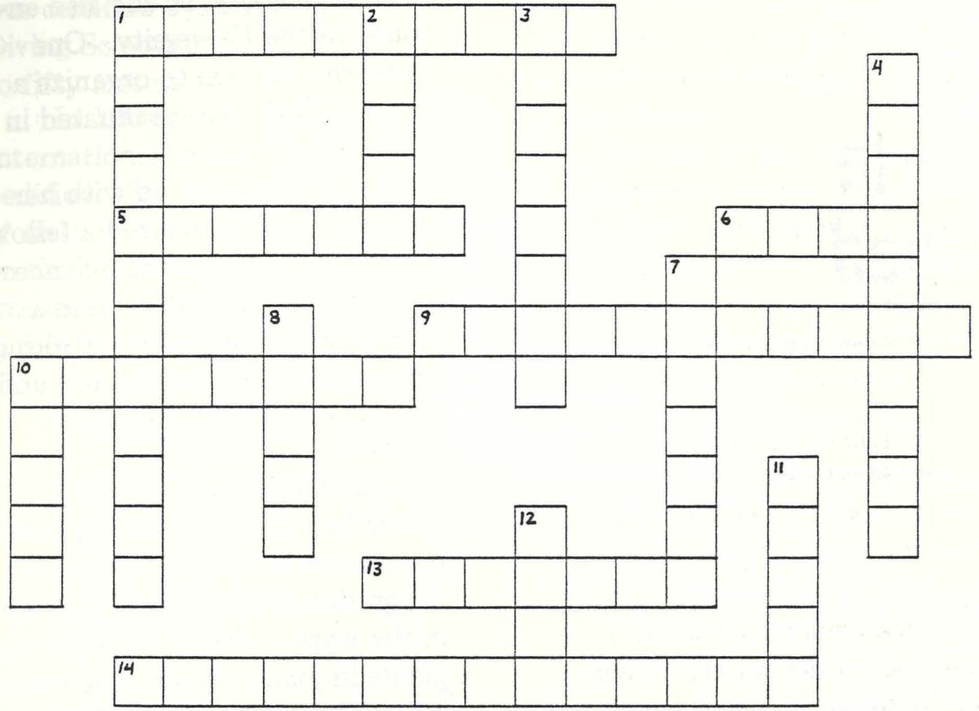
The third book, the *Gold of the Gods*, told of *caves* in Peru and Ecuador that held "metal libraries" of gold leaf documents. According to von Däniken, men from outer space fled their own planet and came to earth. They carved out the huge caves as hiding places for themselves.

Rock drawing from Auanrhet
(Algerian Sahara). Helmet? Antennas?

Von Däniken has published other books on his theories. He has included pictures of some of the drawings found in various cultures that show men in space-like suits and ships. He has included photos of ancient landing strips built in *Peru* and other mysterious things archaeologists can not explain completely.

Many people are interested in von Däniken's theories. However, many religious leaders and scientists are not interested. They say his ideas are incorrect and that he is just trying to make money from people who are not educated enough to know he is wrong. One such doubter was NASA space engineer *Joseph Blumrich*. Blumrich decided he would prove von Däniken wrong. He read the Book of *Ezekiel* and applied the techniques of modern space technology to it. Instead of proving von Däniken wrong, Blumrich became convinced that Ezekiel did see a space ship!

Von Däniken's ideas may prove to be false, or they may prove to be true, but they can not be ignored. They need to be investigated and explored with an open mind.



ACROSS

1. Von Däniken wrote a book, *Gods From* ____ ____.
5. One person who didn't believe the new theories read the book of ____.
6. Another book was ____ *of the Gods.*
9. Country in which von Däniken was born.
10. Von Däniken's first book was ____ *of the Gods?*
13. This book of the Bible caused von Däniken to wonder about things.
14. NASA space engineer who decided to prove von Däniken wrong.

DOWN

1. The priests told von Däniken to read this.
2. Our ancestors may have come from outer ____.
3. Religion of von Däniken.
4. Last name of the man who has many new theories about where humans came from.
7. Von Däniken read many myths and ____.
8. Von Däniken has written many ____.
10. The gold from the gods was put in these things.
11. Von Däniken's first name.
12. Von Däniken wrote about "landing strips" in this country.

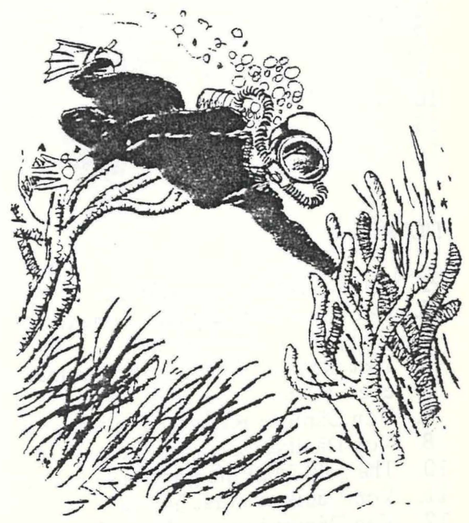
Sylvia Earle Mead

Sylvia *Earle* was born on August 30, 1935, in Gibbstown, New Jersey. Sylvia had two brothers, and she grew up as a "tomboy." She learend to swim in a backyard pool and grew to love the water. Sylvia and her brothers also lived on a small farm. They explored the natural wonders to be found in the area. They collected frogs and snakes and studied them. Their parents did not teach them to be afraid of frogs and snakes. It was from these experiences that Sylvia learned to value ecology and animal life.

The Earle family moved to Florida, which helped Sylvia's love of plants and animals to grow. She became interested in the life found in the sea. After graduating from high school, she attended St. Petersburg Junior College. She was appointed assistant in botany at Florida State University, so she also enrolled at the University. One thing she did was to organize a *Botany* Club. She graduated in 1955.

Sylvia continued with her education. She received a fellowship from the National Science Foundation. She worked as a *marine biologist* besides working on her degrees. Finally, in 1966, she got her Ph.D. from *Duke* University.

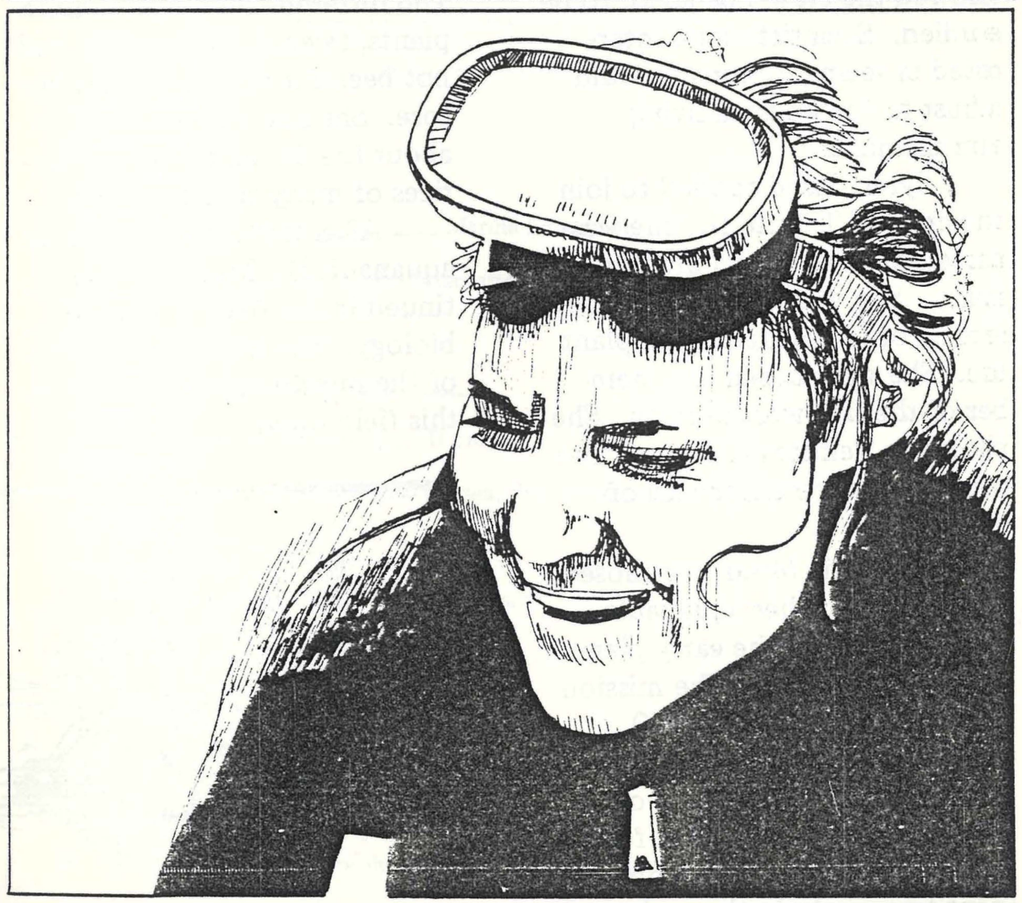
In addition to studying, Sylvia had time to teach herself how to *scuba dive*. She started off gradually and soon was skilled in the water. She studied marine plants in many places. She dived in the Gulf of Mexico and off the coast of North Carolina. She



was certified by Professional Diving Scientists for diving in up to fifty meters of water.

In 1964 Sylvia joined the International Indian Ocean Expedition. She was with a team of sixty men as a marine biologist on the ship *Anton Bruun*. Her work required that she be an excellent scuba diver. She gathered plants and fishes off reefs in water up to fifty meters. She did so well that she went on four other expeditions on the *Anton Bruun*.

Because of her skill, she was appointed research associate of the *Cape Haze* Marine Laboratory. In this post she attended a scientific conference. At this conference she met Giles W. *Mead*. Giles was the curator of fishes at Harvard University.



She married him at Cambridge, Massachusetts, in 1967.

The United States had become involved with the *Tektite* projects. In Tektite I, four scientists had spent two months in an underwater *habitat*. They tested equipment and proved that a person could live below the surface of the seas for long periods of time. This project served two purposes. It provided knowledge of the sea and it also allowed the crew's behavior to be studied. Scientists were interested in seeing if humans could adjust to the unusual living arrangements.

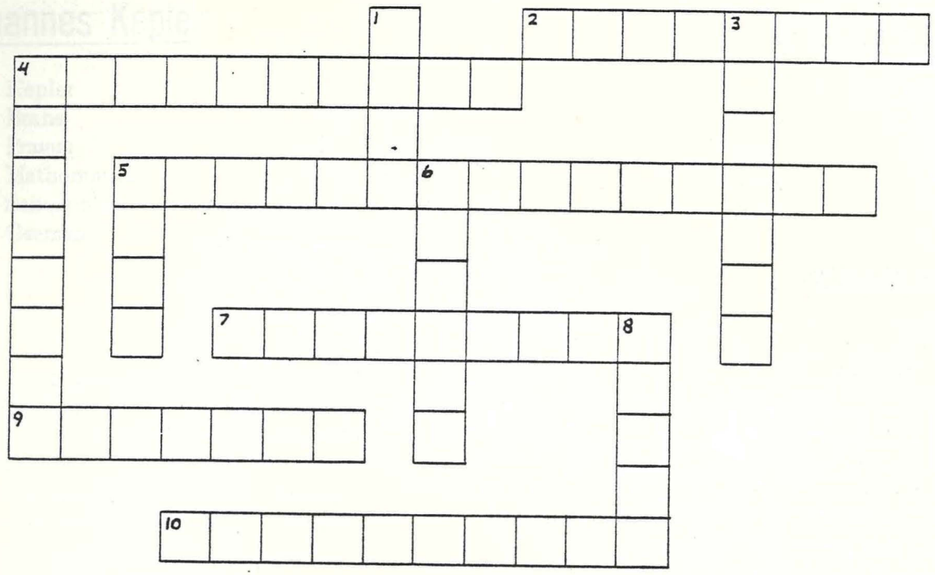
Sylvia Mead applied to join the crew of Tektite II. She was the most experienced diver to apply. She wanted to study the effects of fishes grazing on plant life. She was chosen as a member of the five-woman team. She became a Tektite *aquanaut*. The other teams were made up of men only.

Dr. Sylvia Mead was chosen as the leader of her aquanauts. She was in on all the early planning of the mission. The mission itself began on July 6, 1970. The five women were lowered to the habitat on the floor of Great Lameshur Bay, fifty feet below the surface. The women spent two weeks in the underwater capsule. They did research and were studied during the entire period.

Two days after getting to their habitat, the women got a surprise. They were awakened by the earth shaking! They were in an *earthquake*. They quickly checked the habitat and found it had not been damaged. They were very lucky.

Dr. Mead's research was extremely valuable. She found 153 different species of marine plants, twenty-six of which had not been found in that area before. She also added details about the life and feeding practices of many species of fish.

After her experience as an aquanaut, Dr. Mead has continued in her field of marine biology. She is considered one of the most qualified people in this field today.



ACROSS

2. Sylvia worked at the ____ ____ Marine Laboratory.
4. Name of the ship used by the International Indian Ocean Expedition.
5. Sylvia is a ____ ____.
7. Sylvia taught herself to ____ ____.
9. Sylvia applied to join the ____ II project.
10. After two days of living below the sea, they were awakened by an ____.

DOWN

1. Sylvia got her Ph.D. from ____ University.
3. The living area under the sea was called a ____.
4. In July, 1970, Sylvia became an ____.
5. Sylvia married Giles ____.
6. While in college Sylvia started the ____ Club.
8. Sylvia's last name before she married.

Answers

Archimedes

Across
1. Carthage
5. Syracuse
6. Level
7. Hieron
9. Warrior
11. Rome
12. Bath
13. Conon
14. Gold

Down
1. Circle
2. Egypt
3. Alexandria
4. Fulcrum
8. Crown
10. Ratio

Nicholas Copernicus

1. Nicholas
2. Book
3. Cracow
4. Earth
5. Rheticus
6. Planet
7. Sun
8. Canon
9. Poland
10. Torun
11. Osiander
12. Paul
13. Italy
14. Regiomontanus
15. Frombork

Galileo

Across
3. Newton
4. Pope
5. Padua
6. Heresy
8. Spots
9. Earth
10. Jupiter
12. Sun
13. Galilei
14. Leaning Tower

Down
1. Inquisition
2. Copernicus
4. Pisa
5. Pulse
7. Experiment
11. Kepler

Johannes Kepler

1. Kepler
2. Brahe
3. Prague
4. Mathematics
5. Scholarships
6. Germany
7. Astronomy
8. Styria
9. Rudolphine
10. Earth
11. Linz
12. Telescope
13. Comets
14. Newton
15. Orbits
16. Tubingen
17. Papers

Benjamin Franklin

Across
1. Philadelphia
3. Gulf Stream
7. Royal Society
9. Electricity
10. Boston
12. Pointed
13. Jar

Down
1. Printer
2. Massachusetts
4. Stove
5. Static
6. Key
8. Bifocal
11. Kite

Carl Linnaeus

Across
1. Sweden
4. Doctor
7. Lapland
10. Smith
11. Plants
12. Classification
13. England

Down
1. Symbols
2. Nobles
3. Botany
5. Rashult
6. Amsterdam
8. Clifford
9. Uppsala

Henry Cavendish

1. Nice
2. Newton
3. Henry
4. England
5. Women
6. Electricity
7. Mass
8. Cambridge
9. Shy
10. Gas
11. Maxwell
12. London
13. Gravity
14. Nitric
15. France

Benjamin Banneker

1. Ellicott
2. Experiment
3. Peace
4. Negro
5. Survey
6. Capital
7. Maryland
8. Slaves
9. Almanac
10. Tobacco
11. Baltimore
12. Genius
13. Washington

Joseph Priestley

1. Pennsylvania
2. England
3. Lavoisier
4. Franklin
5. Leeds
6. French
7. Minister
8. Science
9. Aunt
10. London
11. Carbon
12. Brewery
13. Gas
14. Dioxide
15. Soda
16. Oxygen
17. Rubber

Antoine Lavoisier

1. Antoine
2. Book
3. Priestley
4. Chemistry
5. Mazarin
6. Water
7. Marat
8. Revolution
9. Language
10. Oxygen
11. Azote
12. Earth
13. Marie
14. Generale
15. France
16. Measurement
17. Nitrogen
18. Lomonosov
19. Phlogiston
20. Academy
21. Paris
22. Agriculture
23. Taxes
24. Farm
25. Greek

Edward Jenner

1. Edward
2. England
3. Smallpox
4. Louis
5. Doctor
6. China
7. Cowpox
8. Cook
9. London
10. Immune
11. Scarred
12. Vaccination
13. Pacific
14. Hunter

Charles Darwin

1. Westminster
2. Species
3. Galápagos
4. Finches
5. Malthus
6. Bible
7. England
8. Humboldt
9. Cambridge
10. Beagle
11. Ecuador
12. Evolution
13. Natural
14. Theory
15. Wallace
16. Island

Maria Mitchell

Across
2. Librarian
7. Boston
8. Nantucket
9. Vassar
10. William
11. Telescope

Down
1. Mathematics
2. Lynn
3. Astronomy
4. Denmark
5. Comet
6. Quaker

Gregor Johann Mendel

1. DeVries
2. Gregor
3. Vienna
4. Fruit
5. Augustinian
6. Nageli
7. Brünn
8. Priest
9. True
10. Botany
11. Peas
12. Johann
13. Dwarf
14. Hybrid

Thomas Alva Edison

1. Chemicals
2. Conductor
3. Alva
4. Phonograph
5. Menlo
6. Deaf
7. Telegraph
8. Ticker
9. Newark
10. Filament
11. Cylinder
12. Light
13. Typewriter
14. Canada
15. Lefferts

Alexander Graham Bell

Across

3. Edinburgh
4. Graham
5. Deaf
8. Volta
10. Canada
12. Philadelphia
14. Nova Scotia
15. Speech
16. Boston

Down

1. Tuberculosis
2. Watson
3. Edison
4. Garfield
6. Scotland
7. Mabel
9. Telephone
11. Curtiss
13. London

Ivan Pavlov

Across

1. Digestion
4. Priest
6. Sechenov
9. Leningrad
11. Russia
12. Research
13. France

Down

1. Dogs
2. Sleep
3. Medical
5. Ivan
7. Psychic
8. Apes
9. Leningrad
10. Nobel

Jan Ernst Matzeliger

1. Shoemaker
2. Philadelphia
3. Cobbler
4. Employment
5. Engineer
6. Lynn
7. Model
8. South America
9. Shoes
10. Time
11. Negro
12. Pennsylvania

Daniel Hale Williams

1. Palmer
2. Pennsylvania
3. Doctor
4. Daniel
5. Chicago
6. Teach
7. Lawyer
8. Practice
9. Train
10. Provident
11. Knife
12. Heart
13. Surgeon
14. Wisconsin
15. Civil War
16. Negro
17. Nurses

George Washington Carver

1. Germany
2. Peanut
3. Iowa State
4. Race Horse
5. Agriculture
6. Slave
7. Washington
8. Laundry
9. Simpson
10. Neosho
11. Missouri
12. Negro
13. Tuskegee
14. Fort Scott
15. Cotton
16. Plantations

Madame Curie

1. Eve
2. Poland
3. Pierre
4. Science
5. Governess
6. Paris
7. Marie
8. Becquerel
9. Physics
10. America
11. Radium
12. Radioactivity
13. Elements
14. Uranium
15. Irene
16. Sorbonne
17. Chemistry
18. Gram
19. Curie

Lise Meitner

1. Otto
2. Vienna
3. Cambridge
4. Sweden
5. Netherlands
6. Curie
7. Berlin
8. Nurse
9. Hitler
10. Passport
11. Fermi
12. Max
13. Siegbahn
14. Bohr
15. Jew
16. Hahn

Anna Freud

1. Hampstead
2. Sigmund
3. Personality
4. Cancer
5. Hitler
6. Ego
7. Austria
8. England
9. World War I
10. Children
11. Germany
12. Savings
13. Vienna
14. Jewish

Irène Joliot-Curie

1. Assistant
2. Paris
3. Frederic
4. France
5. Chemistry
6. Joliot
7. Sorbonne
8. Blum
9. Radium
10. Nobel Prize
11. Atomic Energy
12. Communism
13. Leukemia
14. Pierre
15. Marie
16. Eve

Linus Carl Pauling

1. Portland
2. Cold
3. Nuclear
4. Helix
5. Corey
6. Resonance
7. Nobel
8. Oregon
9. Peace
10. Protein
11. Diffraction
12. Vitamin
13. Benzene
14. Molecule
15. Chemistry
16. Linus
17. Bond

Enrico Fermi

Across
4. Jewish
5. Neutron
7. Mussolini
9. Element
10. Pisa
11. Uranium
13. United States
14. Germany

Down
1. Physics
2. Chain reaction
3. Atomic Pile
4. Japanese
5. Nuclear
6. Nobel
8. Italy
12. Rome

Margaret Mead

1. Samoan
2. Indian
3. Tau
4. Honolulu
5. Primitive socieities
6. Boas
7. Pennsylvania
8. Columbia
9. Sociologist
10. Fortune
11. *Coming of Age in Samoa*
12. Field Studies
13. Manus
14. Bateson

Louis Leakey

Across
1. Africa
4. Kenya
5. Nairobi
6. Gazelle
11. Richard
12. Rugby
14. Olduvai
15. Jonathan
16. Site
17. Cliff
18. Ax

Down
1. Asia
2. Cutler
3. Cambridge
4. Kikuyu
7. England
8. Mary
9. London
10. Victoria
12. Rudolf
13. Philip

Charles Richard Drew

1. Coach
2. Harvard
3. Canada
4. Stored
5. Plasma
6. Medicine
7. Swimming
8. Montreal
9. McGill
10. Columbia
11. Amherst
12. Beatie
13. World War II
14. Blood
15. Medals
16. Sports
17. Baltimore
18. Washington

Rachel Carson

Across
1. *Sea Around Us*
7. Birds
9. Insects
10. Science
11. Marine
12. Guggenheim
13. Silver Spring

Down
1. *Silent Spring*
2. Springdale
3. Mother
4. Pesticides
5. Writer
6. Farmers
8. Sea

Dorothy Crowfoot Hodgkin

Across

1. Cambridge
3. Cairo
7. Pepsin
8. Nobel
10. Molecule
12. Egypt
13. Bands
14. Biochemistry

Down

1. Computer
2. Robinson
4. Archaeologist
5. Oxford
6. Penicillin
9. England
11. Vitamin

Jacques Cousteau

1. France
2. Aqua-lung
3. Resistance
4. *Silent World*
5. Naval
6. Arms
7. Alsace
8. Lawyer
9. Gagnon
10. Goggles
11. Valve
12. *Calypso*
13. Romanche
14. Piccard
15. Mine
16. Pilot
17. Swim
18. Navy
19. Bathyscaphes
20. Sea
21. Ocean
22. Film

Wernher Von Braun

1. Maria
2. Germany
3. Shuttle
4. Saturn
5. Explorer
6. Houston
7. Kennedy
8. Moon
9. Berlin
10. Peenemunde
11. Himmler
12. Huntsville
13. Americans
14. Alabama

James Alfred Van Allen

Across

2. Miniaturization
4. Orbit
5. Explorer
7. Radiation
9. Physics
11. Fuze
13. Satellite
14. Equator

Down

1. Cosmic
2. Magnetosphere
3. Germans
6. James
8. Sputnik
10. Iowa
12. Lead

Francis Harry Compton Crick

Across

1. Chromosome
4. Northampton
7. Cambridge
8. Helix
9. England
12. Watson
13. Wilkins
14. Radar
15. Nitrogenous

Down

2. Molecular
3. Mines
4. Nobel
5. Acids
6. Proteins
10. London
11. DNA

Jane Goodall

1. Tanganyika
2. Monkey
3. Leakey
4. England
5. Cambridge
6. Hugo
7. Africa
8. Chimpanzees
9. Gorge
10. Notes
11. Hunt
12. London
13. Kenya
14. Nissen
15. Tanzania
16. Communicate
17. Tools
18. Rank
19. Gorilla
20. Koning

Erich von Däniken

Across

1. *Outer Space*
5. Ezekiel
6. *Gold*
9. Switzerland
10. *Chariots*
13. Genesis
14. Joseph Blumrich

Down

1. Old Testament
2. Space
3. Catholic
4. Von Däniken
7. Legends
8. Books
10. Caves
11. Erich
12. Peru

Sylvia Earle Mead

Across

2. Cape Haze
4. Anton Bruun
5. Marine Biologist
7. Scuba Dive
9. Tektite
10. Earthquake

Down

1. Duke
3. Habitat
4. Aquanaut
5. Mead
6. Botany
8. Earle

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